



The Burden of Heart Disease and Stroke *in Missouri*



Missouri Heart Disease and Stroke Prevention Program

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April 2008



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Executive Summary

This report examines the burden of heart disease and stroke in Missouri. Among the sources used are mortality, hospitalization, emergency room data; prevalence of key risk factors; and the U.S. Census (see “Data Sources and Technical Notes,” p. 42). The burden of heart disease and stroke is disproportionately heavy in Missouri, where for both conditions and all modifiable risk factors, Missouri’s rates were consistently higher than U.S. rates.

In Missouri, as in the United States, heart disease is the leading cause of death and stroke is the third-leading cause of death. In 2004, Missouri’s heart disease death rate was 13.5 percent higher than the national rate and the stroke death rate was 11 percent higher. These differentials expanded from 1995 to 2005, despite a decrease of 27 percent in Missouri’s age-adjusted heart disease death rate and a 24 percent decrease in the age-adjusted stroke death rate. In 2005, Missouri’s heart disease death rate was 233.0 per 100,000 population and the stroke death rate was 52.1 per 100,000. With these mortality decreases, Missouri met the 2010 objectives for both coronary heart disease and stroke mortality in 2006. Missouri’s heart disease age-adjusted hospitalization rate of 175.7 per 10,000 population was 17 percent higher than the national rate in 2004 while Missouri’s stroke hospitalization rate of 31.0 was 9 percent higher than the national average.

Heart disease inpatient hospital dispositions in 2005 were 4.5 times more frequent than stroke inpatient hospital dispositions. Heart disease deaths in inpatient hospital settings were statistically significantly lower in 2005 versus 2001. Ischemic stroke inpatient hospital dispositions were nearly 5 times more frequent than hemorrhagic stroke inpatient hospital dispositions. In contrast to ischemic stroke patients, a greater percentage of hemorrhagic stroke patients died.

Prevalence of heart disease and stroke was also higher than the national average as Missouri ranked 9th among the 50 states in heart disease prevalence and 7th in stroke prevalence in 2005.

Missouri also had higher rates than the United States in 2005 for all seven modifiable risk factors studied. These included hypertension, high cholesterol, currently smoking, physical inactivity, not eating fruits and vegetables five times per day, obesity, and diabetes. Reduction in these risk factors could help reduce Missouri’s relatively high heart disease and stroke mortality and prevalence rates.

Heart disease and stroke currently cost the nation more than \$200 billion in direct medical costs, with \$165 billion for heart disease and \$41 billion for stroke. Missouri hospital charges in 2005 for heart disease were nearly \$3 billion and stroke hospital charges were nearly \$500 million.

From 2001 to 2005, the indirect costs measured in terms of lost productivity due to premature deaths from heart disease for Missouri were \$1.75 billion annually. Premature mortality due to stroke in Missouri cost nearly \$251 million in lost productivity annually.

Heart disease death and hospitalization rates were considerably higher for males than for females. Premature (prior to age 65) heart disease death rates were nearly double for males compared to females. Stroke death rates did not vary as much by gender.

Heart disease and stroke death rates among African Americans were one-fourth to one-third higher than for whites. Hospitalization rates were 40-60 percent higher for African Americans than for whites.

Premature heart disease death rates were about double that for whites, while premature stroke death rates were triple corresponding rates for whites.

Another measure of premature mortality is years of potential life lost prior to age 75 (YPLL). Although heart disease and stroke are primarily associated with aging, both still rank in the top ten causes of YPLL, with heart disease ranking 3rd and stroke 8th.

Geographically, high heart disease and stroke death rates were found in the southeast quadrant of the state, the city of St. Louis, and scattered places around the rest of the state during 1995-2005. Seven counties had significantly high heart disease and stroke death rates and heart disease and stroke hospitalization rates. These seven counties were Pemiscot, Mississippi, and Dunklin in the Bootheel; Butler and Iron in southeast Missouri; Henry, southeast of Kansas City; and St. Louis City. Low socioeconomic status is prevalent in these areas and appears to be associated with higher rates of death and hospitalization for heart disease and stroke.

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Missouri ranked 9th among the 50 states in heart disease prevalence and 7th in stroke prevalence in 2005.

Introduction

Missouri (the Show-Me State) is one of the most geographically and culturally diverse states in the nation, with large metropolitan areas, small towns, farmlands and prairies, state and national forests, and recreational and entertainment centers such as Lake of the Ozarks and Branson. Missouri was named for an Algonquian Indian word that means “river of the big canoes” and has 114 counties and one independent city. It is a state with both Midwestern and Southern cultural influences, reflecting its history as a border state between the two regions.

Missouri is the birthplace of many historical figures important not only to the state but also to the entire country, including President Harry Truman, Generals John Pershing and Omar Bradley, George Washington Carver, Samuel Clemens (Mark Twain), Thomas Hart Benton, Jesse James, Yogi Berra, and many others.

The confluence of the Mississippi and Missouri rivers is located in Missouri. The two largest Missouri rivers are the Mississippi, which defines the eastern boundary of the state, and the Missouri, which flows west to east through the state connecting the two largest cities, Kansas City and St. Louis.

North of the Missouri River lie the Northern Plains that stretch into Iowa, Nebraska, and Kansas. Here, gentle rolling hills remain behind from a glacier that had extended from the north to the Missouri River. The Ozark Plateau, part of the Upland South, begins south of the Missouri River and extends into Arkansas, southeast Kansas, and northeast Oklahoma. Springfield in southwestern Missouri lies on the Ozark

Plateau. Southern Missouri is the home of the Ozark Mountains. The southeastern part of the state is home to the Bootheel, part of the Mississippi Alluvial Plain or Mississippi Embayment. This region is the lowest, flattest, and wettest part of the state, and among the most impoverished areas.

The major metropolitan areas include St. Louis and Kansas City. St. Louis, known as the “Gateway to the West,” served as a departure point for explorers, pioneers, and settlers heading to the West, as well as the starting point and the return destination of the Lewis and Clark Expedition. Kansas City, with more fountains than any other city in the country, borders Kansas on the west.

Missouri’s great geographical and cultural diversity has created distinctive regions within the state. Within these regions, there is great variability in terms of population density, with urbanized highly populated areas more dependent on manufacturing and service industries and sparsely populated rural areas more dependent on agriculture, mining, and forestry. Clearly, where Missourians reside in terms of the various regions across the state impacts access to health care services, the quality of those services readily available, the appropriate utilization of hospital and emergency services, and the ability to live healthy lives.

Thus, Missouri’s varied and distinct regions have resulted in differing degrees of burden related to heart disease and stroke. Regionalization has resulted in disparities around the state, with the greatest being in the African-American population in the inner cities and the southeast.

Demographics

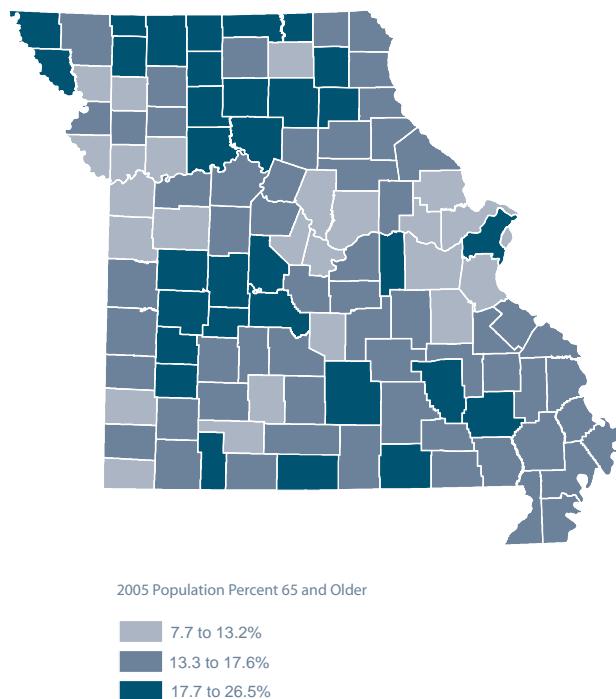
The state of Missouri has a population of 5.8 million people according to the latest U.S. Census¹ estimates, in 2006, so it is 18th among all states. Missouri has a population density of 81 persons per square mile, which mirrors the rest of the nation. Missouri is not growing as fast as the nation as a whole. The U.S. population increased by 6.4 percent from 2000 to 2006. Missouri, meanwhile, has seen a 4.4 percent population increase during the same time period, which ranks 25th among all states.

Missouri has a significant African-American population and a small but growing Hispanic population. Missouri's African-American population has increased slightly as a percentage of the state population recently, from roughly 10.5 percent to 11.5 percent from 1990 to 2000. Missouri is similar to the nation as a whole, which is just over 12 percent African American. One demographic where Missouri differs substantially from the national picture is the Hispanic population. Hispanics make up roughly 14 percent of the total population nationally but account for only 2.6 percent of Missouri's population. This figure places Missouri 39th among all states. Although the percent of Hispanics is still low in Missouri, the Hispanic population is growing rapidly. This segment of the population increased by over 30 percent from 2000 to 2005 after nearly doubling in population from 1990 to 2000.

Like most states in the early part of the 21st century, Missouri's population is growing older. Currently, 13.3 percent of Missourians are 65 and over, which places Missouri 14th among all states. The national average is 12.4 percent. Missouri's percentage is projected to increase

to over 20 percent of the total state population by the year 2030. Map 1 shows the percentage of the population age 65 and over by county. Elderly populations in the state are concentrated in rural areas. Clusters of counties with older populations are found in the north central part of the state and in the areas around the Lake of the Ozarks and Truman Reservoir.

Map 1. Percentage of Missouri Population Age 65 and Older



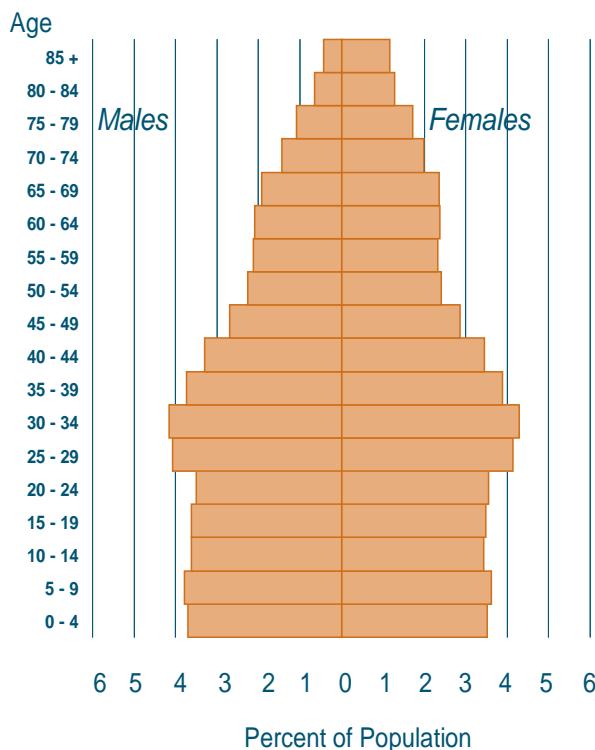
Source: U.S. Census Bureau

The median age for Missouri in 2005 was 37.4 (compared to 36.4 for the nation), placing Missouri 21st among all states. The nation as a whole is getting older at about the same pace as Missouri, gaining 3.5 years in median age since 1990 compared to 3.8 years for Missouri. Age pyramids from 1990 (Figure 1a) and 2005 (Figure 1b) show that the baby boom generation (born from 1946 to 1964) dominates Missouri demographics.

There are large differences in the demographics of the population across Missouri's regions. Most of Missouri's population is located in the St. Louis and Kansas City metropolitan areas. While the metropolitan areas of both cities, and sizable portions of their populations, lie across the state borders in Illinois and Kansas, respectively, the cores of both cities

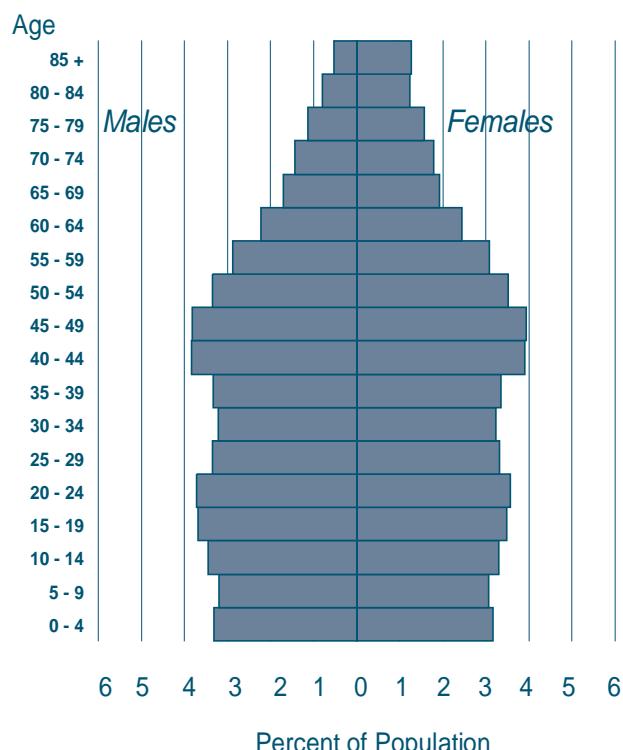
are situated in Missouri. Over half of the state's population (54 percent) falls inside the metropolitan statistical area (MSA) of these two cities, with St. Louis accounting for over one-third of the total state population and Kansas City measuring nearly an additional 20 percent. Missouri has six other cities that are designated as MSA's by the Census Bureau (in order of size: Springfield, Joplin, Columbia, Jefferson City, Cape Girardeau, and St. Joseph). To generalize the growth patterns over the last few decades, Missouri's population has grown the most in the suburban areas of Kansas City and St. Louis and in the more rural central and southwest parts of the state. The population has fallen or stayed static in the urban cores of Kansas City and St. Louis, as well as the largely agricultural lands of northern Missouri and parts of southeast Missouri.

Figure 1a. Age, Gender Distribution of Missouri Population, 1990



Source: U.S. Census Bureau

Figure 1b. Age, Gender Distribution of Missouri Population, 2005



Source: U.S. Census Bureau

Missouri's minority populations are largely clustered in the urban cores of the major cities. Over 80 percent of Missouri's African-American population is located in St. Louis City, St. Louis County, and Jackson County (principal county for Kansas City). There is also a sizable African-American population in a block of counties in the southeast part of the state around Missouri's Bootheel. The largest segment of Missouri's Hispanic population is located in Jackson County (30 percent of all Hispanics in the state). By comparison, St. Louis City and County combined only make up 18 percent of Hispanics. A large portion of Hispanics live in out-state Missouri compared to African-Americans.

Socioeconomically Missouri falls at or just below national averages for various indicators. In 2005, Missouri had a rank of 35th in median household income with a value of \$41,974. In terms of persons below poverty (13.3 percent), Missouri lands right at the national average and has a rank of 20th. Missouri's unemployment rate of 5.4 percent is slightly above the national average of 5.1 percent (Table 1).

Table 1. Socioeconomic Indicators

	Missouri	United States
Median Household Income	\$41,974	\$46,242
% Persons < Poverty	13.3	13.3
% Unemployed	5.4	5.1

Source: Statistical Abstract of the United States, 2005²

There are key regional differences for socioeconomic indicators. Missouri's southeast and south central regions consistently have high poverty rates and rank near the bottom for educational attainment and employment rates.

Background

Heart disease and stroke are, respectively, the first- and third-leading causes of death in both the United States and Missouri. They are the principal causes of cardiovascular disease death and are also major causes of disability. Heart disease is a term that includes several more specific heart conditions. The most common heart disease in the United States is coronary heart disease, which can lead to heart attack.

The risk of coronary heart disease can be reduced by taking steps to prevent and control those adverse factors that put people at greater risk for heart disease and heart attack. Additionally, knowing the signs and symptoms of heart attack, calling 9-1-1, and getting to a hospital with thrombolytic treatment given within 30 minutes are crucial to the most positive outcomes after having a heart attack. People who have had a heart attack can also work to reduce their risk of future events.

A stroke occurs either when the blood supply to part of the brain is blocked or when a blood vessel in the brain bursts, causing damage to a part of the brain. A stroke is sometimes called a brain attack.

Among survivors, stroke can cause significant disability, including paralysis, as well as speech and emotional problems. New treatments such as tissue plasminogen activator (tPA) are available and can reduce the damage caused by a stroke for some victims. These treatments must be given soon after symptoms begin.

Knowing the signs and symptoms of stroke, calling 9-1-1, and getting to a hospital quickly are crucial to the most beneficial outcomes after

having a stroke. The best method to prevent a stroke is to take steps to lower the risk factors.

Types of Heart Disease and Stroke

Coronary heart disease is the most common type of heart disease. It occurs when the coronary arteries, which supply blood to the heart muscle, become hardened and narrowed due to plaque buildup. Plaque buildup and the narrowing and hardening of the arteries is called atherosclerosis. Plaques are a mixture of fatty substances including cholesterol and other lipids. Blood flow and oxygen supply to the heart can be reduced or even fully blocked with growing plaque. Plaque may also rupture and cause blood clots that block arteries. Coronary heart disease can lead to a heart attack.

The most common symptom of coronary heart disease is angina. Angina pectoris is chest pain or discomfort that occurs when the heart muscle is not getting enough blood. Over time, coronary heart disease can weaken the heart muscle and lead to heart failure, a serious problem where the heart cannot pump blood the way that it should. Also, irregular heart beats, called arrhythmias, can develop.

In some people the first sign of coronary heart disease is a heart attack. Doctors can assess a patient's risk status by checking several factors, including blood pressure, blood cholesterol and glucose, history of heart disease, tobacco use, and other factors. Doctors can perform several tests to assess CHD in patients who are at high risk or have symptoms.

For people with coronary heart disease, treatment involves addressing the factors that put them at risk for coronary heart disease and heart attack. The doctor may recommend lifestyle changes to help reduce risk. Medications and medical treatments may be needed. Medications are available to treat high blood cholesterol, high blood pressure, irregular heartbeats, blood flow, and other potential problems. Some advanced treatments and surgical procedures may be used to help restore blood flow to the heart muscle.

A heart attack is also called a myocardial infarction. The most common signs of a heart attack are:

1. Chest discomfort in the center of the chest that lasts for more than a few minutes or goes away and comes back. It can feel like pressure, squeezing, fullness, or pain,
2. Discomfort in other areas of the body, possibly in one or both arms, the back, neck, jaw, shoulder, or stomach,
3. Shortness of breath may come along with or before chest discomfort,
4. Other signs may include breaking out in a cold sweat, nausea, vomiting, weakness, or lightheadedness.

If the blood supply to the heart is severely reduced or completely blocked, heart muscle cells may not receive enough oxygen and begin to die. The more time that passes without treatment to restore blood flow, the greater the damage to the heart. This damage can cause irregular heart rhythms or even sudden cardiac arrest or stopping of the heartbeat. Death can result. Coronary artery disease is the chief

underlying cause of a heart attack. A less common cause of a heart attack is a severe spasm of a coronary artery that reduces the blood supply to the heart.

When a person is having a heart attack, emergency care is needed that may include cardiopulmonary resuscitation (CPR), electrical shock or defibrillation using an automatic external defibrillator (AED), and other advanced emergency medical care. Emergency medical personnel can quickly perform emergency treatment and transport the person to the hospital. Bystanders might also be trained to perform CPR and to use an AED, if one is available, until emergency medical personnel arrive. Once at the hospital, doctors can perform several tests to quickly determine if the person is having or has had a heart attack and the best course of action to restore blood flow. The sooner emergency treatment is administered, the greater a person's chance of surviving a heart attack.

A heart attack survivor may have a damaged heart that affects the heart rhythm, pumping action, and blood circulation. If so, the heart attack victim is at greater risk of having another heart attack or other events such as a stroke, kidney problems, and peripheral arterial problems. Cardiac rehabilitation is usually recommended for heart attack survivors after the emergency event has stabilized. Cardiac rehabilitation guides the patient to make changes that can help improve cardiovascular fitness and quality of life. These changes may include dietary changes, physical activity, smoking cessation, and other issues such as medication schedules and stress management. Heart attack survivors should seek a doctor's advice about daily activities such as returning to work, driving, physical and sexual activity, and air travel.

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Heart disease and stroke are, respectively, the first- and third-leading causes of death in both the United States and Missouri.

Stroke is a sudden loss of consciousness resulting when the rupture or occlusion of a blood vessel leads to oxygen deprivation in the brain. There are two main types of stroke: ischemic (the most common) and hemorrhagic. Ischemic stroke can be further divided into two types: thrombotic stroke and embolic stroke. Thrombotic strokes are caused by a thrombus (blood clot) that develops in the arteries supplying blood to the brain. An embolic stroke occurs when a blood clot arises in a blood vessel in another part of the body (e.g., a carotid artery) or the heart and migrates to the brain and blocks a blood vessel. It most commonly occurs when a cardiac rhythm disturbance is present (e.g., atrial fibrillation).

Ischemic strokes can also be caused by a narrowing of the arteries, called stenosis. The most common cause of stenosis is atherosclerosis. In atherosclerosis, plaque (a mixture of fatty substances including cholesterol and other lipids) and blood clots build up inside the artery walls, causing thickening, hardening, and loss of elasticity. These lead to decreased blood flow.

Tissue plasminogen activator (tPA) is the only FDA-approved drug for treating ischemic stroke shortly after symptom onset by helping to dissolve the blood clot.

A hemorrhagic stroke occurs when an artery in the brain bursts. A hemorrhage can occur in several ways. One cause is an aneurysm, a weak or thin spot on an artery wall that can expand like a balloon. The thin walls of the stretched artery can rupture or break. A hemorrhage also occurs when arterial walls lose their elasticity and become brittle and thin. They can then crack and bleed. This can happen with atherosclerosis. High blood pressure increases the risk of a hemorrhagic stroke.

There are two main types of hemorrhagic stroke. An intracerebral hemorrhage occurs when a blood vessel in the brain leaks blood into the brain itself. A subarachnoid hemorrhage is bleeding under the outer membranes of the brain and into the thin, fluid-filled space that surrounds the brain.

A transient ischemic attack (TIA) is sometimes called a mini-stroke. It starts just like a stroke, but symptoms clear within 24 hours. A TIA is a warning that the person is at risk for a more serious stroke. For most TIAs, the symptoms go away within an hour. When symptoms begin, there is no way to tell whether it will be a TIA or a more serious stroke. The sudden onset of the symptoms of a stroke signal an emergency. Anyone experiencing symptoms should not wait to see if they go away.

Only a clinician can diagnose stroke, but there are three questions that identify signs of stroke. If a person has difficulty with responding to the following instructions, it may indicate that the person has experienced or is experiencing a stroke and 9-1-1 should be called immediately.

1. Ask the person to smile. (Does the person understand and move both sides of their face evenly and with equal ease?)
2. Ask the person to close their eyes and raise both arms. (Does the person understand and move both arms to the same level with ease?)
3. Ask the person to repeat a simple sentence. (Do they understand and is their speech understandable?)

The five signs and symptoms of stroke are:

1. Sudden confusion or trouble speaking,
2. Sudden numbness or weakness of face, arm, or leg, especially on one side,
3. Sudden trouble seeing in one or both eyes,
4. Sudden trouble walking, dizziness, or lack of balance,
5. Severe headache with no known cause.

References: Information for this section was abstracted from the Centers for Disease Control and Prevention web site at: <http://www.cdc.gov/heartdisease/index.htm>; <http://www.cdc.gov/heartdisease/about.htm>; <http://www.cdc.gov/stroke/>; and http://cdc.gov/stroke/about_stroke.htm.

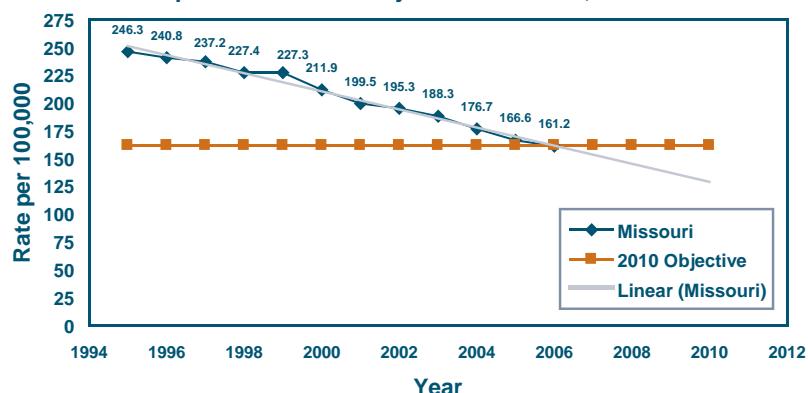
Healthy People 2010 Objectives

Healthy People 2010³ is a comprehensive set of disease prevention and health promotion objectives for the nation to achieve over the first decade of the 21st century. It was created by experts both in and out of government and identifies a wide range of specific measurable objectives. For heart disease and stroke, there are two specific mortality objectives. Coronary heart disease age-adjusted death rates (a subset of heart disease) should be reduced to 162.0 per 100,000 population, while stroke mortality should be reduced to 50.0 per 100,000.

As Figure 2 shows, in 1995 Missouri's coronary heart disease was 52 percent higher than the 2010 objective, and in 2000 it was still 31 percent higher. The 2006 death rate of 161.2 per 100,000 was just below the 2010 objective of 162.0. The linear regression of Missouri's current trends indicates that Missouri's coronary heart disease death rate will be approximately 20 percent below this objective in 2010.

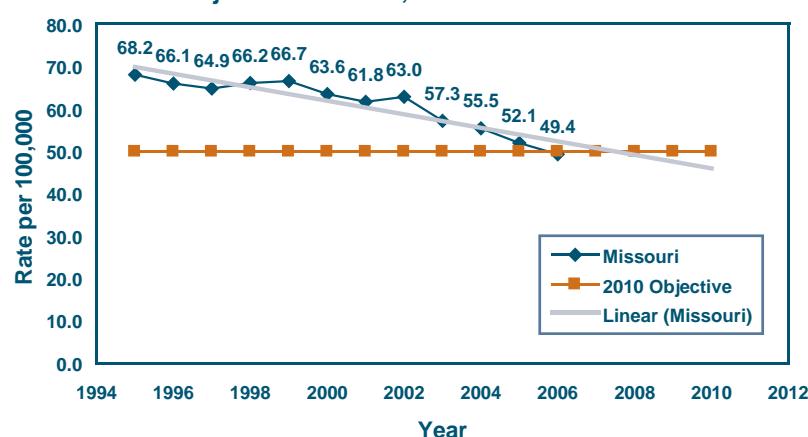
Similar to the coronary heart disease objective, stroke mortality was 36 percent above the 2010 objective of 50.0 per 100,000 population in 1995, 27 percent above it in 2000, but just below it according to the 2006 data (49.4 versus 50.0). As Figure 3 shows, the trend line indicates that Missouri's stroke death rate will be about 8 percent below this objective in 2010.

Figure 2. Age-Adjusted Death Rates for Coronary Heart Disease Compared with 2010 Objective: Missouri, 1995-2006



Source: DHSS at <http://www.dhss.mo.gov/DeathMICA/indexcounty.html>

Figure 3. Age-Adjusted Death Rates for Stroke Compared with 2010 Objective: Missouri, 1995-2006



Source: DHSS at <http://www.dhss.mo.gov/DeathMICA/indexcounty.html>

Mortality

In 2005, 14,818 Missourians died from heart disease while 3,316 died from stroke, representing more than one out of every three Missouri resident deaths. Heart disease has been the leading cause of death in Missouri since the 1920s, while stroke has ranked number three since the 1940s. Cancer has ranked between the two. As Table 2 shows, in 2004, the latest comparable year, Missouri's age-adjusted heart disease death rate of 246.4 was 13.5 percent higher than the

national rate, while the Missouri stroke death rate was 11.0 percent higher. Crude death rates, which do not adjust for differences in age distribution, show Missouri 20.7 percent higher for heart disease and 18.4 percent higher for stroke. The greater differentials in crude death rates primarily reflect Missouri's older population compared to the United States as a whole. As Table 2 shows, Missouri's proportion of deaths due to heart disease and stroke is higher than the nation's.

Table 2. Ten Leading Causes of Death by Selected Indicators: United States and Missouri, 2004

	U.S. Rank	MO Rank	Number		Crude Rate		Age-Adj. Rate		Percent of Total		% Diff. MO/U.S.	Crude Age Rate	Adj. Rate
			U.S.	MO	U.S.	MO	U.S.	MO	U.S.	MO	U.S.		
Heart Disease	1	1	652,486	15,432	222.2	268.2	217.0	246.4	27.2	28.7	20.7	13.5	
Cancer	2	2	553,888	12,429	188.6	216.0	185.8	200.5	23.1	23.1			
Stroke	3	3	150,074	3,483	51.1	60.5	50.0	55.5	6.3	6.5	18.4	11.0	
Chron. lung dis.	4	4	121,987	2,738	41.5	47.6	41.1	44.1	5.1	5.1			
Unintent. injuries	5	5	112,012	2,639	38.1	45.9	37.7	44.6	4.7	4.9			
Diabetes	6	6	73,138	1,466	24.9	25.5	24.5	23.6	3.0	2.7			
Alzheimer's	7	8	65,965	1,384	22.5	24.1	21.8	21.8	2.8	2.6			
Influenza & pneu.	8	7	59,664	1,406	20.3	24.4	19.8	22.3	2.5	2.6			
Nephritis	9	9	42,480	1,080	14.5	18.8	14.2	17.3	1.8	2.0			
Septicemia	10	(11)	33,373	696	11.4	12.1	11.2	11.1	1.4	1.3			
Suicide	(11)	10	32,439	728	11.0	12.7	10.9	12.5	1.4	1.4			
Total Deaths			2,398,365	53,787	816.7	934.7	801.1	866.8	100.0	100.0	14.4	8.2	

Sources: DHSS at <http://www.dhss.mo.gov/DeathMICA/indexcounty.html> and National Center for Health Statistics at <http://www.cdc.gov/nchs/data>

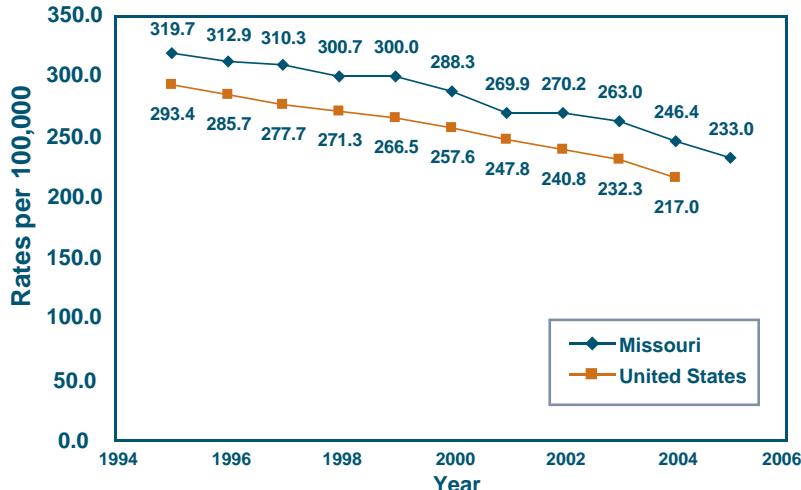
Figure 4 shows that even though heart disease rates in the United States and Missouri have declined steadily, Missouri's rate has consistently been higher than the national rate throughout the previous decade. The national rate has decreased at a faster pace; the difference between the two rates has expanded from 9.0 percent in 1995 to 13.5 percent in 2004.

Stroke mortality trends show a similar pattern to heart disease. Figure 5 shows that Missouri's stroke death rate has been higher than the United States rate for every year from 1995 to 2004. Both rates have decreased, but the national rate has decreased at a faster pace. In 1995, Missouri's stroke death rate was 8 percent higher than the U.S. rate, while by 2004 the differential had increased to 11 percent.

THE BURDEN IN MISSOURI

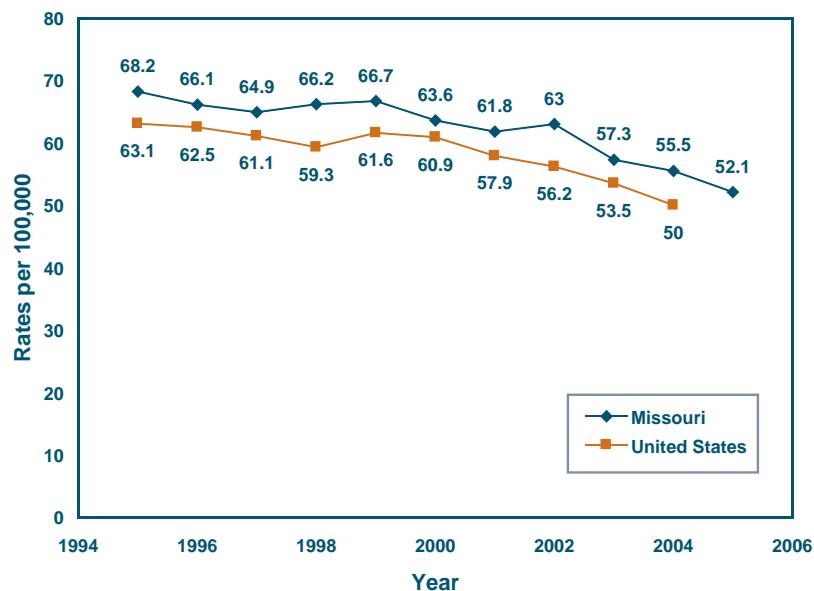
Heart disease has been the leading cause of death in Missouri since the 1920s, while stroke has ranked number three since the 1940s.

Figure 4. Age-Adjusted Death Rates for Heart Disease: Missouri and United States, 1995-2005



Sources: DHSS at <http://www.dhss.mo.gov/DeathMICA/indexcounty.html> and National Center for Health Statistics at <http://www.cdc.gov/nchs/data>

Figure 5. Age-Adjusted Death Rates for Stroke: Missouri and United States, 1995-2005



Sources: DHSS at <http://www.dhss.mo.gov/DeathMICA/indexcounty.html> and National Center for Health Statistics at <http://www.cdc.gov/nchs/data>

Figure 6 shows that Missouri heart disease mortality has generally been much higher for males than for females. In 2005, males had an age-adjusted death rate nearly 50 percent higher than females. However, the differential between the two genders has been decreasing, as in 1995 there was nearly a 60 percent difference. From 1995 to 2005 the male death rate for heart disease decreased by about 30 percent compared to a 25 percent decrease for females.

Despite these differentials, heart disease is still the leading cause of death for both genders. In fact, for all the years from 1995 to 2005, there were more female heart disease deaths than male deaths. In 2005, there were 7,638 heart disease deaths to Missouri females and 7,180 deaths to males. This apparent contradiction with the age-adjusted rates by gender occurs because the female population is generally older than the male population. Approximately two-thirds of all heart disease deaths occur to persons aged 75 and older. The female population age 75 and over represented 8.1 percent of the total female population in 2005, and males aged 75 and over represented 5.0 percent of the total male population. In terms of the total population, females 75 and over represented 4.06 percent of the total population and males 75 and over represented 2.45 percent of the total population.

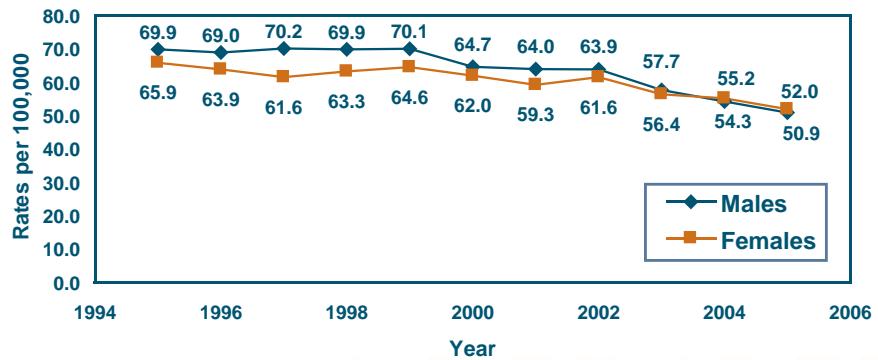
Figure 7 shows that age-adjusted death rates generally show much less differential by gender for stroke mortality than for heart disease mortality. In fact, in 2004 and 2005 female stroke mortality surpassed that of males. From 1995 to 2005, stroke mortality dropped 27 percent for males and 21 percent for females. In 1995, male mortality was 6 percent higher than that for females and by 2005 male stroke mortality was 2 percent less than female stroke mortality.

Figure 6. Age-Adjusted Death Rates for Heart Disease by Gender: Missouri, 1995-2005



Source: DHSS at <http://www.dhss.mo.gov/DeathMICA/indexcounty.html>

Figure 7. Age-Adjusted Death Rates for Stroke by Gender: Missouri, 1995-2005



Source: DHSS at <http://www.dhss.mo.gov/DeathMICA/indexcounty.html>

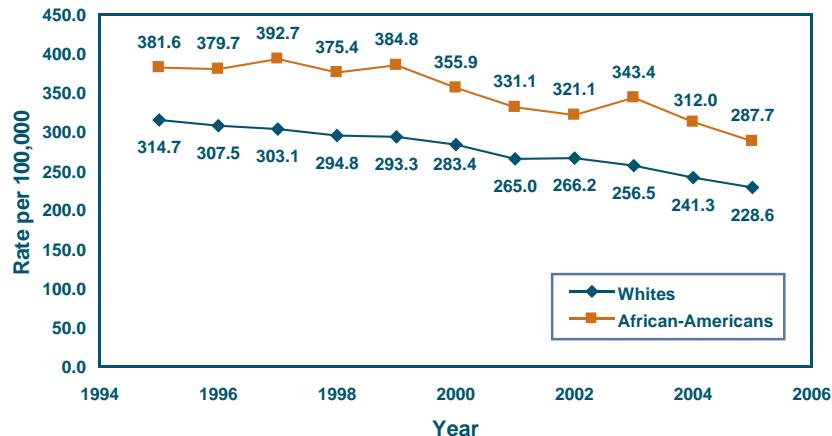
The age-adjusted heart disease death rate for African Americans was consistently higher than that for whites throughout the 1995-2005 decade (Figure 8). In 2005, the African Americans' rate of 287.7 was 26 percent higher than for whites. The gap between the two rates has expanded slightly as in 1995 there was a 21 percent differential between the two races. The rate for whites declined at a slightly faster pace than for African Americans (27.4 versus 24.6 percent, respectively).

Stroke mortality was also consistently higher among African Americans than among whites from 1995 to 2005. The gap (about one-third higher for African Americans) was about the same at the beginning of the period in 1995 as at the end in 2005 (Figure 9).

THE BURDEN IN MISSOURI

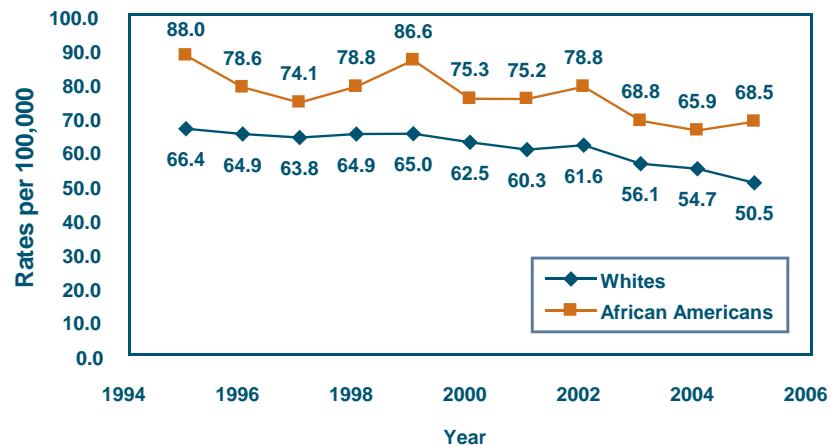
In 2005, more than one out of every three deaths in Missouri were from heart disease or stroke.

Figure 8. Age-Adjusted Death Rates for Heart Disease by Race: Missouri, 1995-2005



Source: DHSS at <http://www.dhss.mo.gov/DeathMICA/indexcounty.html>

Figure 9. Age-Adjusted Death Rates for Stroke by Race: Missouri, 1995-2005



Source: DHSS at <http://www.dhss.mo.gov/DeathMICA/indexcounty.html>

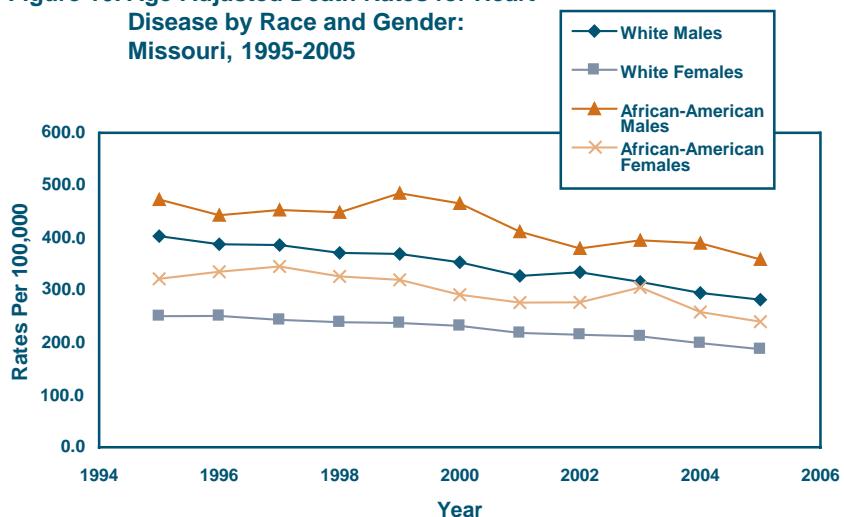
African-American males had the highest heart disease death rates for 1995-2005, followed by white males, then African-American females, with white females having had the lowest death rates for all years (Figure 10). All rates have declined sharply, with white males showing the largest decrease. In 2005, the rate for highest risk group (African-American males) was nearly double the rate for the lowest risk group (white females).

As Figure 11 shows, stroke mortality showed more fluctuation by race and sex than heart disease did from 1995 to 2005, partly because of smaller numbers. Unlike heart disease, race appears to be more important than gender for stroke as African-American males and African-American females had the highest rates in 2005, followed by white females and white males.

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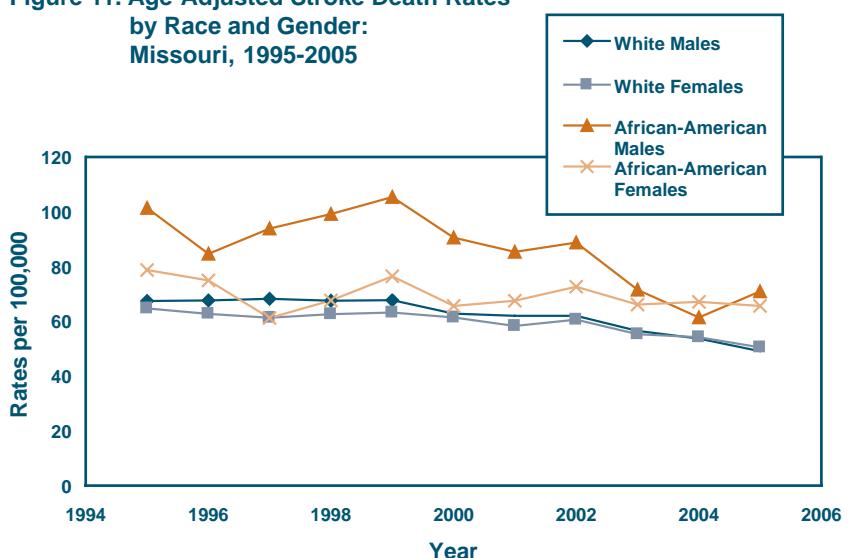
Heart disease and stroke death rates were consistently higher for African Americans than for whites from 1995 to 2005.

Figure 10. Age-Adjusted Death Rates for Heart Disease by Race and Gender: Missouri, 1995-2005



Source: DHSS at <http://www.dhss.mo.gov/DeathMICA/indexcounty.html>

Figure 11. Age-Adjusted Stroke Death Rates by Race and Gender: Missouri, 1995-2005



Source: DHSS at <http://www.dhss.mo.gov/DeathMICA/indexcounty.html>

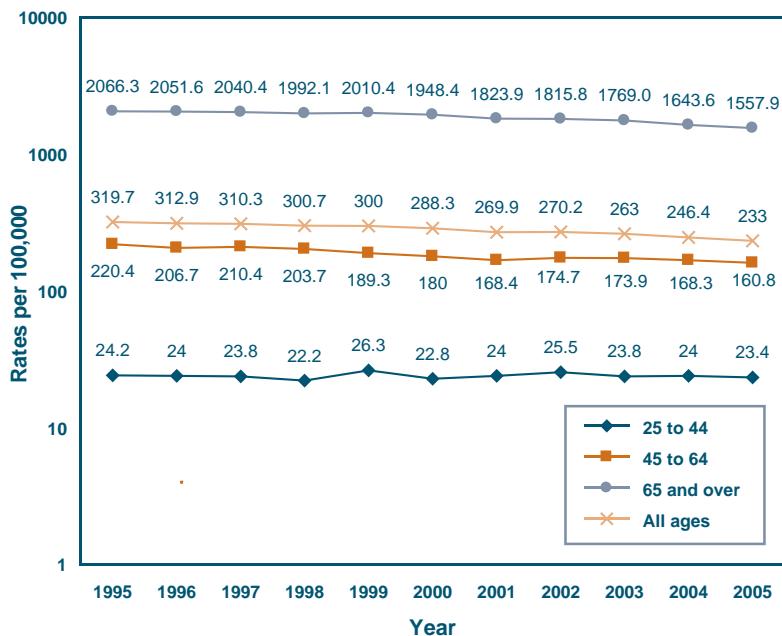
As one would expect, both heart disease and stroke mortality are highly correlated with age. Mortality is much more common in the older ages. Heart disease death was about 10 times more likely for people aged 65 and over compared to those aged 45-64 in 2005. Stroke mortality was 14 times more likely for the same age groups and same year.

Improvements in mortality rates for both heart disease and stroke from 1995 to 2005 were substantial for both the 45-64 and 65 and over age groups. For people aged 25-44, there was very little improvement in mortality (Figures 12 and 13).

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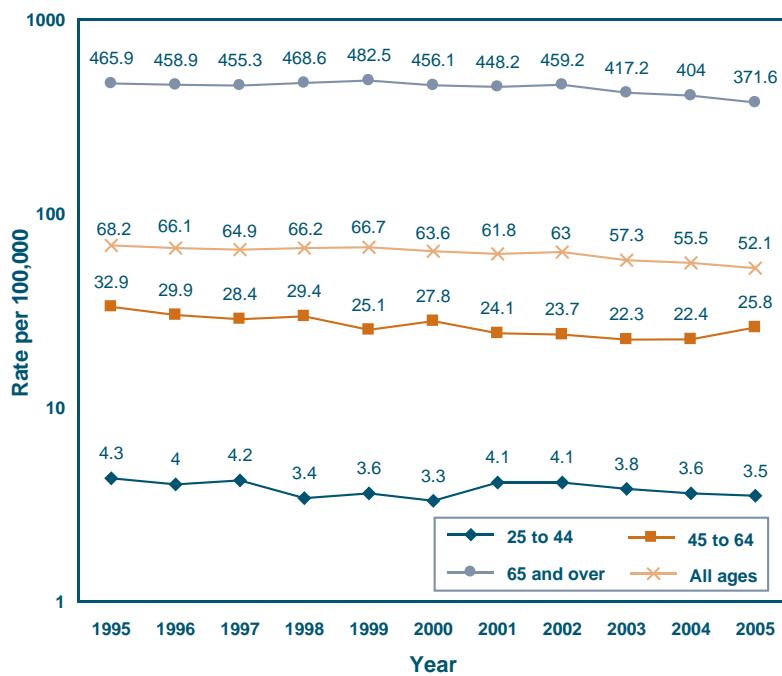
Heart disease mortality was about 10 times more likely and stroke mortality was about 14 times more likely for people 65 and older compared to those 45-64.

Figure 12. Heart Disease Death Rates per 100,000 by Age Groups: Missouri, 1995-2005



Source: DHSS at <http://www.dhss.mo.gov/DeathMICA/indexcounty.html>

Figure 13. Stroke Death Rates per 100,000 by Age Groups: Missouri, 1995-2005



Source: DHSS at <http://www.dhss.mo.gov/DeathMICA/indexcounty.html>

Men are much more likely than women to die prematurely (under age 65) from heart disease. Death rates in 2005 were about 2.4 times greater for men than for women aged 25-44 and 45-64. On the other hand, stroke death rates were nearly the same by gender for these age groups. By race, heart disease death rates under age 65 for African Americans were about double rates for whites while premature stroke death rates were more than three times the rates for whites (Table 3).

Another measure of premature mortality is years of potential life lost prior to age 75 (YPLL). Although heart disease and stroke are primarily associated with aging, both still rank in the top ten causes of YPLL, with heart disease ranking 3rd and stroke 8th (Figure 14). Stroke causes more years of disability than heart disease,⁴ but because stroke deaths are less numerous and more concentrated in ages 75 and over, stroke causes fewer YPLL than heart disease. Cancer and unintentional injuries are the two leading causes of YPLL, as both are associated with younger ages at death than heart disease and stroke. For African-American Missourians,

Table 3. Premature Heart Disease and Stroke Death Rates by Age Groups, Gender, and Race: Missouri, 2005

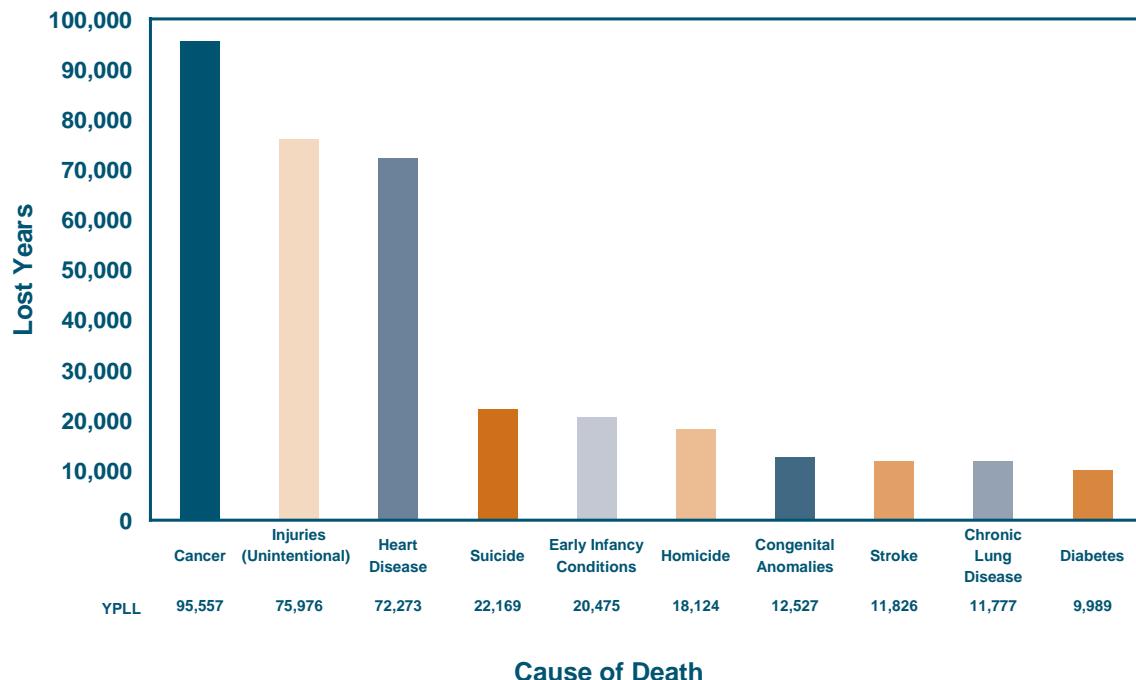
Age Group	Heart Disease		Stroke	
	Males	Female	Males	Females
25-44	32.2	14.6	3.5	3.5
45-64	229.6	95.9	27.2	24.4
			African	African
			Whites	Americans
25-44	21.1	44.7	2.7	9.3
45-64	149.8	272.5	21.3	69.5

Rates are per 100,000 population

Source: DHSS at <http://www.dhss.mo.gov/DeathMICA/indexcounty.html>

heart disease ranked second in YPLL for both males and females (surpassed by homicide and by cancer, respectively).

Figure 14. Years of Potential Life Lost, Selected Conditions: Missouri, 2005



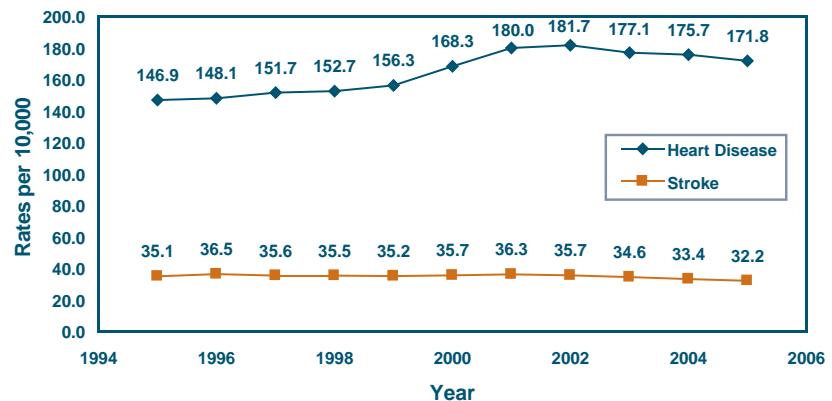
Hospitalizations and Emergency Room Visits

In 2005, there were 107,323 inpatient hospitalizations of Missouri residents for heart disease and 20,188 hospitalizations for stroke. Heart disease hospitalizations represented about 13.9 percent of all hospitalizations (770,990) in the state, and stroke accounted for another 2.6 percent. Thus, about one in six Missouri inpatient hospitalizations was due to heart disease or stroke in 2005. It should be noted that these counts are not unduplicated, as the same person may have been hospitalized multiple times.

Emergency room (ER) visits due to heart disease or stroke are somewhat lower than inpatient hospitalizations because ER visits are not counted if the patient is later admitted into the same hospital. In 2005, 55 percent of heart disease hospitalizations and 59 percent of stroke hospitalizations were admitted through the ER. Thus, the ER visit rates primarily include those that were admitted to the ER and then sent home or those that died in the ER.

In 2005, there were 76,797 ER visits for Missourians due to heart disease and 4,939 due to stroke. Heart

Figure 15. Heart Disease and Stroke Age-Adjusted Hospitalization Rates: Missouri, 1995-2005



Source: DHSS at <http://www.dhss.mo.gov/InpatientHospitalizationMICA/indexcounty.html>

disease and stroke represented 3.7 and 0.2 percent, respectively, of the more than 2 million emergency room visits in the state.

Hospitalizations due to heart disease and stroke did not follow the continuous downward path followed by mortality from 1995 to 2005. As Figure 15 shows, the hospitalization rate for heart disease increased from 146.9 per 10,000 population in 1995 to a peak of 181.7 in 2002 and then decreased to 171.8 in 2005. The stroke hospitalization rate increased slightly from 35.1 in 1995 to 36.3 per 10,000 in 2001 and then decreased to 32.2 in 2005.

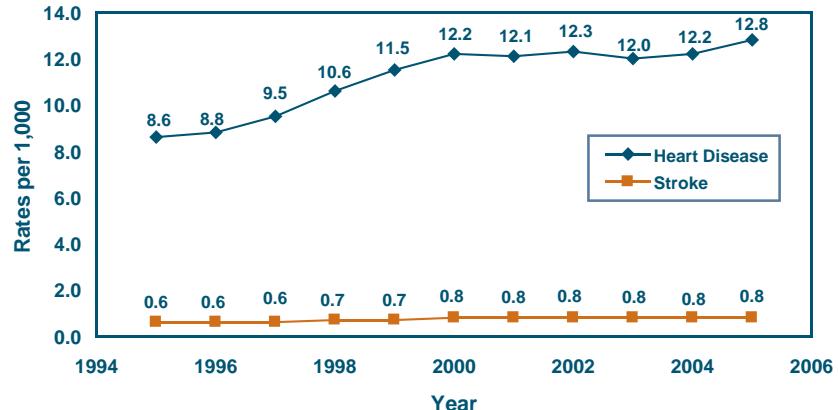
In 2005, there were more than 7 hospitalizations for each heart disease death compared to just 4.4 in 1995. For stroke, these ratios increased from 5.1 in 1995 to 6.1 stroke hospitalizations per stroke death. These patterns suggest that medical interventions may have played a significant role in the heart disease and stroke mortality decreases.

As with mortality, Missouri also has higher hospitalization rates for heart disease and stroke than the national rates. In 2004 (the latest year available in the National Center for Health Statistics database), Missouri's inpatient hospitalization rate for heart disease (175.7 per 10,000 population) was 17 percent higher than the national rate of 149.6, while Missouri's stroke hospitalization rate of 33.4 was 8 percent higher than the United States rate of 31.0 per 10,000 population.⁵

ER visits due to heart disease and stroke followed similar patterns. As Figure 16 shows, both rates rose sharply from 1995 to 2000 and then leveled off from 2000 to 2005. The heart disease rate for ER visits rose by 42 percent from 1995 to 2000 from 8.6 to 12.2 per 1,000 population, and then rose an additional 5 percent to 12.8 in 2005. Stroke ER visits rose 33 percent from 0.6 per 1,000 in 1995 to 0.8 in 2000 and have remained at that rate since then.

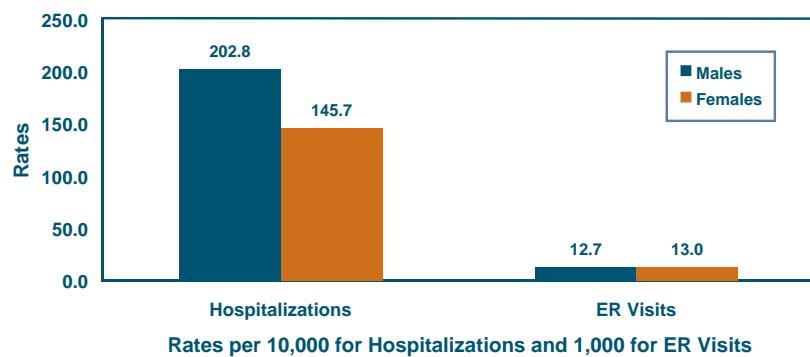
As with mortality, male heart disease hospitalization rates were distinctly higher than those for females (202.8 versus 145.7 per 10,000, respectively). The gap between the two genders' hospitalization rates decreased from 47 percent in 1995 to 39 percent in 2005. Heart disease ER visit rates were slightly lower for males than for females (12.7 versus 13.0, respectively) (Figure 17).

Figure 16. Heart Disease and Stroke Age-Adjusted ER Visit Rates: Missouri, 1995-2005



Source: DHSS at <http://www.dhss.mo.gov/InpatientEmergencyRoomMICA/indexcounty.html>

Figure 17. Age-Adjusted Hospitalization and ER Visit Rates by Gender for Heart Disease: Missouri, 2005



Source: DHSS at <http://www.dhss.mo.gov/InpatientHospitalizationMICA/indexcounty.html>

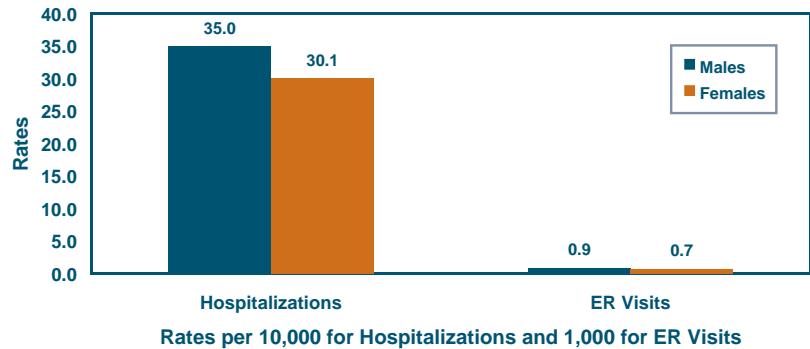
Stroke hospitalization rates were 16 percent higher for males than for females in 2005 while ER visit rates were also higher for males, although the rates for both genders were less than 1 per 1,000 (Figure 18).

As with mortality, heart disease and stroke hospitalization rates were higher for African Americans than for whites. Figure 19 shows heart disease hospitalization rates were 37 percent higher for African Americans than for whites in 2005 while stroke rates were 62 percent higher (Figure 20). For ER visits, African Americans had rates 66 percent higher than whites for heart disease and 13 percent higher for stroke.

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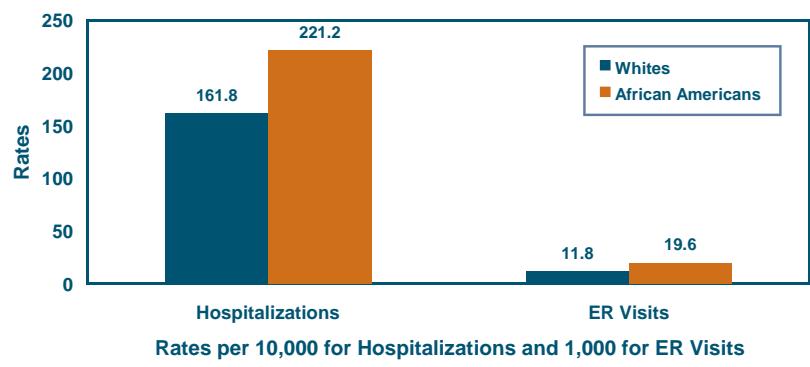
As with mortality, heart disease and stroke hospitalization rates were higher for African Americans than for whites.

Figure 18. Age-Adjusted Hospitalization and ER Visit Rates by Gender for Stroke: Missouri, 2005



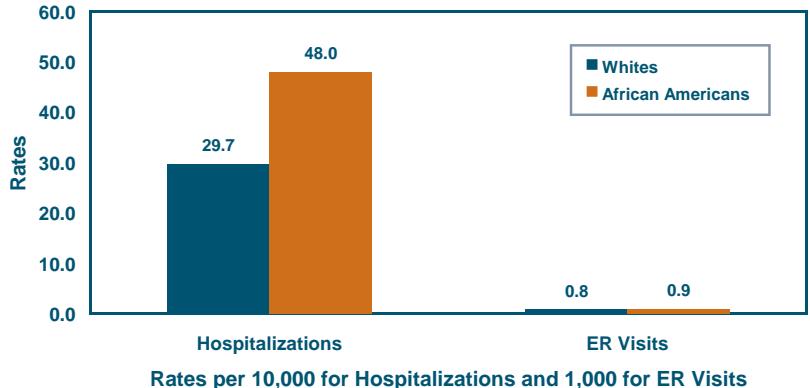
Source: DHSS at <http://www.dhss.mo.gov/InpatientHospitalizationMICA/indexcounty.html>

Figure 19. Age-Adjusted Hospitalization and ER Visit Rates by Race for Heart Disease: Missouri, 2005



Source: DHSS at <http://www.dhss.mo.gov/InpatientHospitalizationMICA/indexcounty.html>

Figure 20. Age-Adjusted Hospitalization and ER Visit Rates by Race for Stroke: Missouri, 2005



Source: DHSS at <http://www.dhss.mo.gov/InpatientHospitalizationMICA/indexcounty.html>

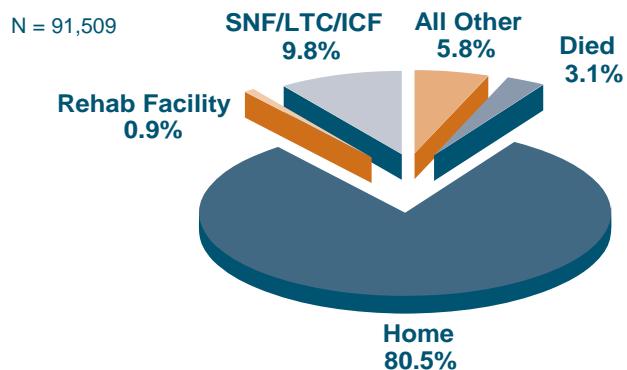
Hospital Discharge Dispositions

The main discharge dispositions from acute care hospitals for inpatients under treatment for heart disease and stroke are home; rehabilitation facilities; long-term care institutions, including skilled nursing facilities (SNF), long-term care facilities (LTC), intermediate care facilities (ICF); all other; and death. "All other" includes, for example, transfers to other inpatient hospitals and unknowns.

Figures 21 and 23 illustrate these hospital discharges for individuals with heart disease and stroke. The major types of stroke in inpatient hospital settings include ischemic, transient cerebral ischemia, and hemorrhagic (Figure 22). Additional pie charts (Figure 24 and Figure 25) provide more detail regarding the two major types of stroke, ischemic stroke and hemorrhagic stroke.

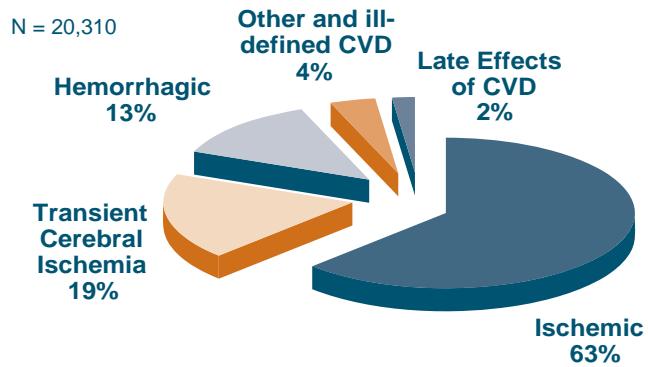
Heart disease inpatient hospital dispositions were 4.5 times more frequent than stroke inpatient hospital dispositions. Although 2001 data are not presented, heart disease deaths in inpatient hospital settings are statistically significantly lower in 2005 versus 2001. This development may reflect enhanced systems of cardiac care, including improved medical and hospital care and enhanced therapeutic drugs, such as greater use of statin drugs for lipid management and hypertension drugs for blood pressure control.

Figure 21. Heart Disease Inpatient Hospital Dispositions: Missouri, 2005



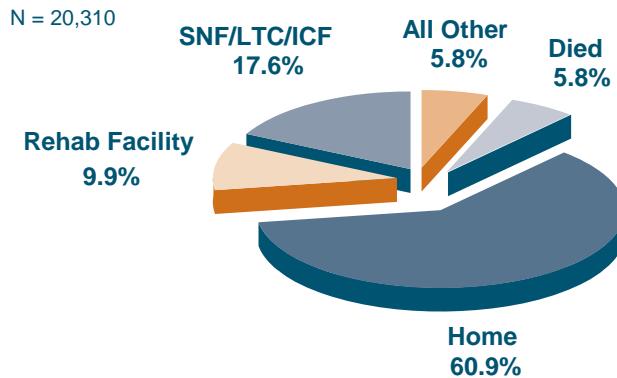
Source: 2005 Patient Abstract System, Missouri Department of Health and Senior Services

Figure 22. Types of Stroke among Hospital Discharges: Missouri, 2005



Source: 2005 Patient Abstract System, Missouri Department of Health and Senior Services

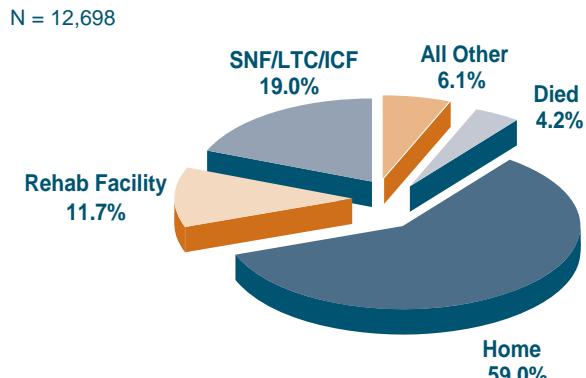
Figure 23. Stroke Inpatient Hospital Dispositions: Missouri, 2005



Source: 2005 Patient Abstract System, Missouri Department of Health and Senior Services

In contrast to heart disease dispositions, a greater percentage of stroke patients die while in inpatient settings, are discharged to rehabilitation facilities and institutional care, and a smaller percentage of stroke patients are discharged home.

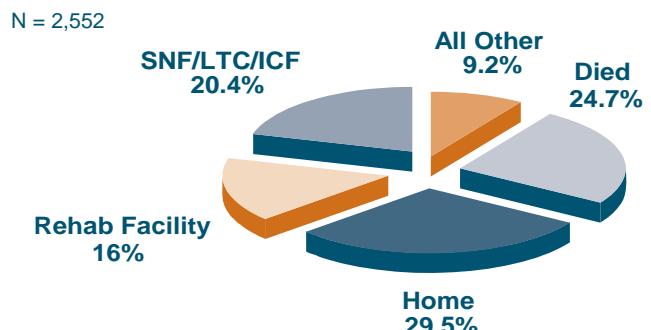
Figure 24. Ischemic Stroke Inpatient Hospital Dispositions: Missouri, 2005



Source: 2005 Patient Abstract System, Missouri Department of Health and Senior Services

Ischemic stroke inpatient hospital dispositions are nearly five times more frequent than hemorrhagic stroke inpatient hospital dispositions. In contrast to hemorrhagic stroke patients, a greater percentage of ischemic stroke patients are discharged home.

Figure 25. Hemorrhagic Stroke Inpatient Hospital Dispositions: Missouri, 2005



Source: 2005 Patient Abstract System, Missouri Department of Health and Senior Services

In contrast to ischemic stroke patients, a greater percentage of hemorrhagic stroke patients die and a smaller percentage of hemorrhagic stroke patients are discharged home from inpatient facilities.

Reference: In 1993, following the enactment of RSMo 192.665–192.667, the Patient Abstract System was implemented. It includes outpatient data as well as inpatient data.

Prevalence

Estimates of the number of Missourians who have heart disease or have had a stroke come from the Behavioral Risk Factor Surveillance System (BRFSS).⁶ Because the BRFSS is a telephone sample of non-institutionalized residents, it underestimates the prevalence of these conditions, especially for stroke. Nursing home residents and others who are too ill to respond to the survey are excluded from the sample. In addition, persons without landlines are excluded, and the overall response rate was 58 percent in 2005 for those with landlines.

Based on BRFSS responses in 2005, 4.8 percent of Missourians aged 18 and older (over 200,000 people) have been diagnosed with either coronary heart disease or angina. The percentage that responded that they have had a heart attack (5.2 percent) was actually larger than the percentage responding that they had coronary heart disease, even though heart attack is a subset of those with coronary heart disease. (Thus, some respondents may have misunderstood the question or they may not understand the definitions of coronary heart disease, angina, and heart attack). About 3.4 percent of respondents indicated that they had had a stroke, representing about 147,000 Missourians.

Missouri's heart disease and stroke prevalence both rank in the top 10 in the country among the 50 states, ranking 9th for heart disease and 7th for stroke.^{7,8}

Table 4 shows the sharp differences in prevalence of these diseases by socioeconomic level. People with less than a high school education reported heart attack rates more than three times those with a college

education, while those in households making less than \$15,000 reported heart attack rates four times those making more than \$75,000. For stroke, these differentials were even greater, with those in the lowest education and income groups reporting stroke prevalence rates more than six times the rate of those in the highest groups.

Consistent with the mortality findings, males reported a higher rate of heart attacks and coronary heart disease than females but a slightly lower rate of stroke. The coronary heart disease and stroke prevalence differentials by gender were not statistically significant. In contrast with the mortality findings, whites reported a higher prevalence of heart disease and stroke than African Americans. The rates for African Americans were based on very small numbers and thus should be interpreted with caution. Response rates were also generally lower for African Americans as only 7.8 percent of Missouri 2005 BRFSS respondents were African American compared with 11.5 percent of the state's population.

Table 4. Percentage of Heart Attack, Angina, or Coronary Heart Disease, and Stroke by Selected Demographic Variables: Missouri, 2005

Demographic Variable	Heart Attack or Myocardial Infarction	Angina or Coronary Heart Disease	Stroke
Male	6.4	5.6 (NS)	3.1 (NS)
Female	4.1	4.1	3.6
Whites	5.3	4.9 (NS)	3.4 (NS)
African American	2.7	3.3	2.0
18-24	0.2	0.8	0.0
25-34	0.5	0.0	0.3
34-44	2.4	1.6	0.8
45-54	3.7	3.3	5.3
55-64	8.3	9.1	5.3
65+	15.6	14.5	11.4
Less than H.S.	10.7	8.5	8.5
High School Grad.	5.8	5.1	3.8
Some Post H.S.	4.0	4.3	2.8
College Grad.	3.3	3.4	1.3
Less than \$15,000	10.2	9.6	9.4
\$15,000-24,999	5.8	6.5	6.4
\$25,000-34,999	7.0	5.4	2.8
\$35,000-49,999	3.0	3.5	1.6
\$50,000-74,999	3.4	3.0	0.9
\$75,000+	2.5	2.3	1.4
Total	5.2	4.8	3.4

Notes: Differences between highest and lowest demographic groups are statistically significant, except where noted with (NS).

Source: Missouri BRFSS

Knowledge of Symptoms

Missouri's 2005 Behavioral Risk Factor Surveillance System (BRFSS) contained questions that assessed respondents' knowledge of heart attack and stroke symptoms and asked what they would do first if they thought someone was having a heart attack or stroke. All respondents were asked if the following symptoms were signs of a heart attack: pain or discomfort in the jaw, neck, or back; feeling weak, lightheaded, or faint; chest pain or discomfort; sudden trouble seeing in one or both eyes; pain or discomfort in the arms or shoulder; and shortness of breath.

All respondents were also asked if the following symptoms were signs of a stroke: sudden confusion or trouble seeing; sudden numbness or weakness of the face, arm, or leg, especially on one side; sudden trouble seeing in one or both eyes; chest pain or discomfort; sudden trouble walking, dizziness, or loss of balance; and severe headache with no known cause. It should be noted that trouble seeing out of one or both eyes is a sign of a stroke while chest pain is a sign of a heart attack. Respondents were also asked what they would do first if they thought someone was having a heart attack or stroke, and the correct answer was to call 9-1-1.

Table 5 shows that only 14.7 percent correctly responded to all knowledge questions about heart attacks, and just 19.1 percent correctly answered all the stroke knowledge questions correctly. However, more than half correctly answered each individual symptom

question. For heart attacks, the symptom least recognized was pain in the jaw, neck, or back, while for stroke the least recognized symptom was severe headache with no known cause.

As with prevalence, there were strong socioeconomic differences in knowledge. Those with greater than a high school education were more than twice as likely to answer all heart attack knowledge questions correctly and three times as likely to answer all stroke questions correctly as those without a high school diploma. Whites were more likely to answer the knowledge questions correctly than African Americans. Females had better knowledge of the heart attack questions than males, but the same knowledge of stroke symptoms.

Approximately 86 percent of respondents said they would call 9-1-1 if they thought someone was having a heart attack or stroke. This did not vary much by demographic characteristic.

Table 5. Knowledge of Heart Attack and Stroke Symptoms: Missouri, 2005

	Weighted Percentage Answering "Yes"
Heart Attack	
Pain in the jaw, neck, or back	52.7
Feeling weak, lightheaded, or faint	65.4
Chest pain or discomfort	95.2
Trouble seeing out of one or both eyes*	44.9
Pain or discomfort in the arms or shoulders	88.4
Shortness of breath	83.5
Correct knowledge of all symptoms and one symptom not a heart attack symptom	14.7
<i>*Not a symptom of heart attack</i>	
Stroke	
Sudden confusion or trouble speaking	87.3
Sudden numbness or weakness of face, arm, or leg, especially on one side	93.6
Sudden trouble seeing in one or both eyes	66.0
Chest pain or discomfort**	38.9
Sudden trouble walking, dizziness, or loss of balance	83.2
Severe headache with no known cause	53.7
Correct knowledge of all symptoms and one symptom not a stroke symptom	19.1
Would call 911 first if thought someone was having a heart attack or stroke	85.9
<i>**Not a symptom of stroke</i>	

Source: Missouri BRFSS

For the individual questions and composite knowledge indicator, respondents with missing data or refused were excluded. "Do not know/not sure" responses were considered "no" and included in the denominator. For the composite knowledge indicator, respondents had to answer to all six questions correctly (five "yes" and one "no").

Modifiable Risk Factors

The Centers for Disease Control and Prevention (CDC), with the help of state health departments, has been tracking a number of heart and stroke modifiable risk factors for several decades, as has the Behavioral Risk Factor Surveillance System (BRFSS). Among these risk factors are hypertension, high cholesterol and diabetes prevalence, current smoking, physical inactivity, eating less than five fruits and vegetables per day, and obesity.

As Table 6 shows, for each of these seven indicators Missouri had a higher prevalence in 2005 than the United States overall. Missouri's rank

among the 50 states was in the top half for all the risk factors. The highest rank at number 6 was for high blood cholesterol as 38.7 percent of Missourians age 18 and older who have been tested indicated that a health care provider had told them that they had a high cholesterol level compared with 35.6 percent of the nation's residents. Missouri also had rankings in the top 15 for current smoking, obesity, and hypertension. The high prevalence of these modifiable risk factors is probably a key reason why Missouri also has high death rates for heart disease and stroke.

Table 6. Percent Prevalence of Selected Modifiable Risk Factors: Missouri and United States, 2005

Risk Factor	Missouri	United States	Missouri Rank
Hypertension	27.3	25.5	15
High Blood Cholesterol	38.7	35.6	6
Current Smoker	23.4	20.6	11
Physical Inactivity	25.4	23.8	22
Fruits/Veg. <5 times/day	77.4	76.8	20
Obesity	26.9	24.4	12
Diabetes	7.7	7.3	19

Source: CDC at <http://apps.nccd.cdc.gov/brfss>

Table 7 presents the Missouri trends for these seven indicators from 1995 (or the closest available year of data to 1995) to 2005. Only two of the risk factors have improved since 1995. They are smoking cigarettes, which decreased by 18.2 percent from 1996 to 2005 from 28.6 to 23.4 percent, and physical inactivity, which decreased from 30.2 percent in 1996 to 25.4 percent in 2005. Diabetes prevalence nearly doubled from 1995 to 2005 while obesity increased by more than 42 percent.

Being told by a doctor that one had hypertension increased by one-fifth and high blood cholesterol by one-third from 1995 to 2005. These increases may reflect a number of factors, including better awareness of

representative sample of persons aged 20-74. The frequency of eating fruits and vegetables less than five times a day had the highest prevalence among the seven risk factors rate, 77.4 percent in both 1996 and 2005.

Table 8 shows differences in modifiable risk factors by gender, race, and education level in 2005. The only statistically significant difference by gender was for eating less than five fruits and vegetables per day, with men being more likely to have this risk factor. African Americans were significantly more likely to have hypertension and diabetes and to be physically inactive than their white counterparts. By education level,

Table 7. Trends in Modifiable Risk Factors: Missouri, 1995-2005

Risk Factor	Percent Prevalence		Percent Change
	1995	2005	
Hypertension	23.0	27.3	18.7
High Blood Cholesterol	28.8	38.7	34.4
Current Smoker*	28.6	23.4	-18.2
Physical Inactivity**	30.2	25.4	-15.9
Fruits/Vegetables <5 times/day**	77.4	77.4	0.0
Obesity	18.9	26.9	42.3
Diabetes	4.1	7.7	87.8

*Earliest available year 1997 **Earliest available year 1996

Source: Missouri BRFSS

hypertension and high cholesterol, rather than a *real* increase in blood pressure and cholesterol readings. The National Health and Nutrition Examination Survey⁹ showed that the national rate of total cholesterol (>239 mg/L) per individual decreased slightly in the 1990s, and blood pressure greater than or equal to 140/90 mm Hg remained about the same nationally according to actual readings of a nationally

there were several strong differences in the rates of modifiable risk factors. Those with less than a high school education were more than twice as likely to be a current smoker, to be physically inactive, or to have diabetes than those with at least some college education. Those with lower education levels were also more likely to have hypertension and to not eat at least five fruits and vegetables per day.

Table 8. Age-adjusted Modifiable Risk Factors by Sex, Race and Education Level: Missouri, 2005

Risk Factor	Gender			Race	African American			Education Level		
	Male	Female	Sig.		White	African American	Sig.	<High School	High School	>High School
Hypertension	29.4	25.4	NS	26.7	35.8	S	38.0	28.5	25.5	S
High Blood Cholesterol	29.5	29.1	NS	29.8	24.7	NS	29.0	28.8	29.5	NS
Current Smoker	24.6	22.8	NS	22.9	22.5	NS	47.7	28.0	18.2	S
Physical Inactivity	23.8	26.1	NS	24.0	32.5	S	44.2	32.3	17.4	S
Fruits/Veg. <5/day	81.2	73.8	S	78.0	78.4	NS	86.8	82.9	72.6	S
Obesity	27.2	26.3	NS	25.9	31.4	NS	27.7	27.9	24.7	NS
Diabetes	8.1	7.4	NS	7.1	15.5	S	15.5	7.7	6.1	S

Significance: S=Statistically significantly different at .05 level, NS=Not statistically significant

Source: Missouri BRFSS at <http://www.dhss.mo.gov/BRFSS.2005AnnualReport.pdf>

Hospital Charges and Medicaid Costs

In 2005, hospital charges for heart disease in Missouri were nearly \$3 billion (Table 9), \$27,804 for each hospital discharge due to diseases of the heart and \$514 for each man, woman, and child in the state. Stroke cost a little less than \$500 million, \$22,978 per discharge and about \$80 per Missouri citizen. The \$3.4 billion in hospital charges due to heart disease and stroke accounted for 22.6 percent of all hospital charges in Missouri. The average length of stay for stroke patients was 4.9 days, compared with 3.9 for heart disease patients

and 4.7 days for all patients. It should be noted that charges are just an indicator of costs. A study by Haddix, et al.,¹⁰ indicated that charges represent about double actual costs. This information was based on cost-to-charge ratios by state, which are used by Medicare to reimburse hospitals and providers for health care services. But hospital charges also do not include other medical costs associated with heart disease and stroke, such as physician, medication, outpatient, and nursing home costs.

Table 9. Heart Disease and Stroke Hospital Discharges, Charges, Days of Care: Missouri, 2005

	Discharges	Days of Care	Charges (millions)	Avg. Days of Care	Avg. Charges/ Discharge	Avg. Charges/ Mo. Resident
Heart Disease	107,323	421,310	\$2,984	3.9	\$27,804	\$514.45
Stroke	20,188	99,328	\$464	4.9	\$22,978	\$79.98

Source: DHSS at http://www.dhss.mo.gov/D_C_DofCMICA/indexcounty.html

THE BURDEN IN MISSOURI

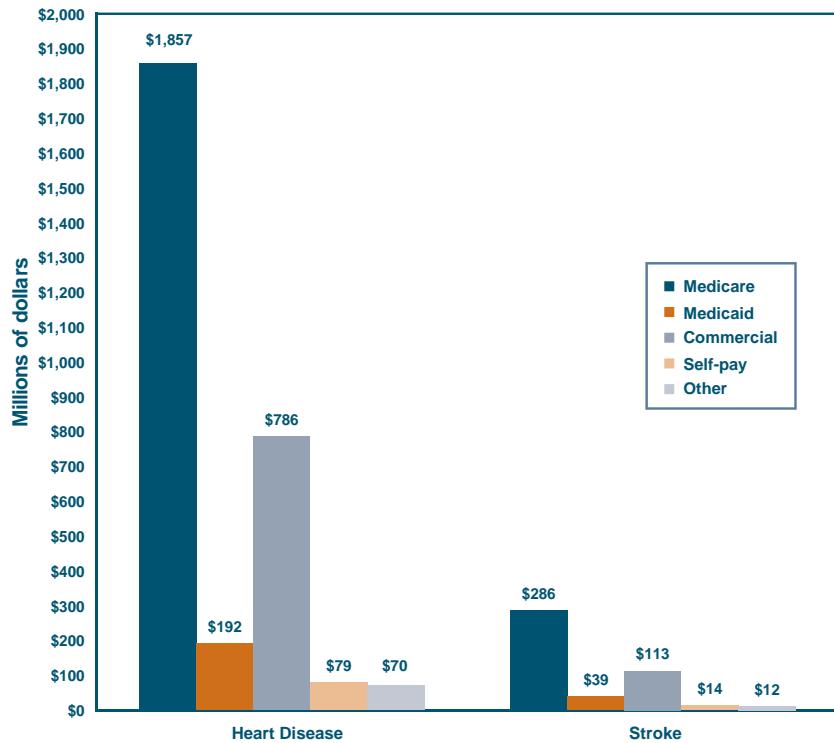
Hospital charges were nearly \$3 billion for heart disease and \$500 million for stroke in 2005 in Missouri.

The pattern of charges by principal source of payment was very similar for heart disease and stroke as shown in Figure 26. Medicare accounted for more than 60 percent of the hospital charges for both heart disease and stroke. This amounted to more than \$2 billion. Another \$231 million came from Medicaid funding, and about \$900 million in hospital charges came from commercial sources.

Nationally, it has been estimated that all direct medical costs (including hospital, nursing home, physician, etc.) for heart disease in 2007 will be \$164.9 billion, with an additional \$41.6 billion for stroke.¹¹ Nearly half of the stroke costs were estimated to be related to nursing home and home health care due to the greater disability associated with stroke. Only about one-sixth of heart disease costs related to these types of costs.

Missouri Medicaid costs were examined using April–June 2007 paid claim files. Projecting to a full year, approximately \$200 million per year are paid by Medicaid for heart disease and another \$120 million are paid for stroke. Nursing home payments accounted for more than 40 percent of the heart disease paid claim amounts and more than 60 percent of the stroke Medicaid payments.

Figure 26. Heart Disease and Stroke Hospital Charges by Principal Source of Payment: Missouri, 2005



Source: DHSS at http://www.dhss.mo.gov/D_C_DofCMICA/indexcounty.html

Productivity Losses

From 2001 to 2005, the indirect costs measured in terms of lost productivity¹² due to premature deaths resulting from heart disease for Missouri were \$1.75 billion, annually (Table 10). Seventy-eight percent of these productivity losses resulted from male deaths, despite the fact that they were only 48 percent of all heart-disease-related deaths.

Most of the productivity losses (81 percent) due to heart-disease-related deaths were in whites followed by African Americans (17

percent) and other races. Disproportionately higher productivity losses were found for males due to lower age at death and because more males are in occupations paying higher salaries.

From 2001 to 2005, premature mortality due to stroke in Missouri cost nearly \$251 million in lost productivity annually (Table 11). Sixty-four percent of the productivity losses were among males, attributable to lower female salaries and lower age at death for males.

Table 10. Productivity Losses Due to Premature Death Caused by Heart Disease in Dollars: Missouri, 2001-2005

	Male	%	Female	%	Both Sexes
All Heart	\$1,362,595,311	78	\$388,985,273	22	\$1,751,580,584
White	\$1,124,905,688	79	\$299,701,856	21	\$1,424,607,545
African-American	\$213,552,979	72	\$84,716,234	28	\$298,269,213

Table 11. Productivity Losses Due to Premature Death Caused by Stroke in Dollars: Missouri, 2001-2005

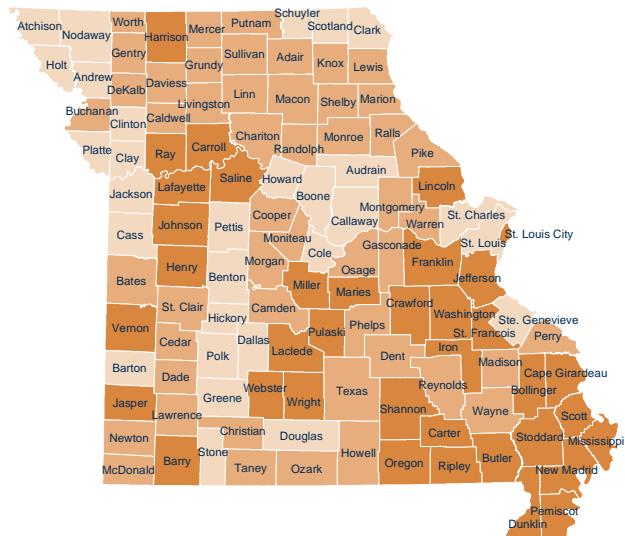
	Male	%	Female	%	Both Sexes
All Stroke	\$161,259,874	64	\$89,563,199	36	\$250,823,073
White	\$124,249,844	64	\$68,397,096	36	\$192,646,940
African-American	\$35,106,196	63	\$20,490,374	37	\$55,596,571

Geographic Disparities

The maps and the appendix in this report show areas of the state that have high and low rates of heart disease and stroke mortality and hospitalization rates. Counties are shaded according to whether their rates are significantly higher or lower than the state rate for 1995–2005 data. Eleven years of data were used so that all 115 counties have at least 20 events, making them more stable statistically.

Map 2 shows that high age-adjusted heart disease mortality occurred in southeastern Missouri, in St. Louis City, counties southwest of St. Louis, several counties in south central Missouri, and several counties east of Kansas City. Low rates were found in central and northwest Missouri and in suburban St. Louis and Kansas City counties. The highest heart disease death rate occurred in Pemiscot County, located in the Bootheel, with an age-adjusted rate of 456.1 per 100,000 population, which was more than 60 percent higher than the Missouri rate of 282.3. The next six highest counties were also located in the southeastern quadrant of the state and include Washington, Mississippi, Carter, New Madrid, Dunklin, and Iron counties. All had rates more than 30 percent higher than the state rate.

Map 2. Heart Disease Mortality: Missouri, 1995–2005



Age-Adjusted Heart Disease Mortality Rates

Missouri State Rate = 282.3 (per 100,000)

- Light orange: Significantly Lower than State Rate
- Medium orange: Not Significantly Different
- Dark orange: Significantly Higher than State Rate

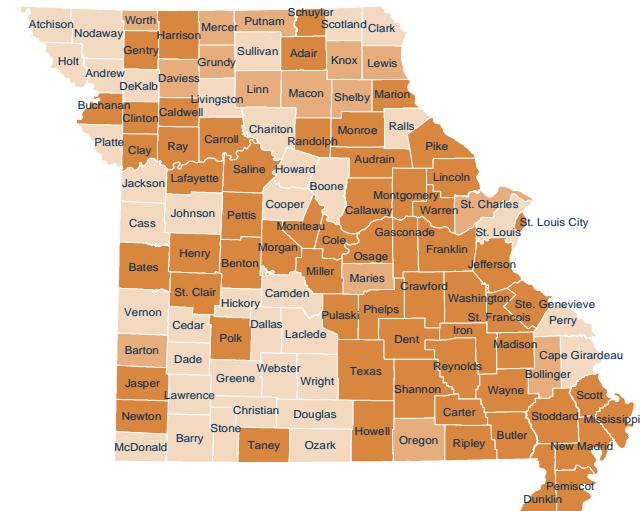
Map 3 on heart disease hospitalizations shows many more counties were significantly higher or lower than the state rate compared to the mortality map because the numbers of hospitalizations are much larger and therefore almost any difference is statistically significant. Generally counties with high heart disease death rates also have high heart disease hospitalization rates. For example, residents from Pemiscot County also had the highest heart disease inpatient hospitalization rate in the state, followed by Reynolds, St. Clair, Carter, and Washington counties. Among these counties, only St. Clair did not have a significantly higher death rate for heart disease. Low hospitalization rates were found in southwest Missouri, St. Louis County, parts of central and northwest Missouri, and the Kansas City metropolitan area. It should be noted that counties in the corners of the state, such as McDonald, Atchison, Lewis, and Clark, may have abnormally low hospitalization rates because many of their residents receive services out of state.

Map 4 shows that stroke mortality is more scattered than heart disease mortality, probably because the smaller number of stroke deaths creates more variation. However, residents in St. Louis City and many of the counties of southeastern Missouri also have high stroke mortality rates. The highest stroke death rates were found among residents in Daviess County, followed by Dunklin, Worth, Henry, and Holt counties. Low rates were located in the Kansas City and St. Louis metropolitan areas.

Map 5 shows that stroke hospitalization rates were also high in southeastern areas of the state, as well as St. Louis City and parts of northeastern and western areas of the state. Low rates were found in southwestern and south central parts of the state as well as St. Louis suburban counties and Cass and Johnson counties south of Kansas City.

Map 6 summarizes counties that were either significantly high for both heart disease mortality and hospitalizations or both stroke mortality and hospitalizations. There were 27 counties that were high for both heart disease indicators and 13 that were high for both stroke indicators. There were seven counties that were high for all four heart disease and stroke indicators. Five of these seven counties were located in southeastern Missouri--Pemiscot, Dunklin, Mississippi, Butler, and Iron counties. The other two high-risk counties were St. Louis City and Henry County.

Map 3. Heart Disease Hospitalizations: Missouri, 1995-2005

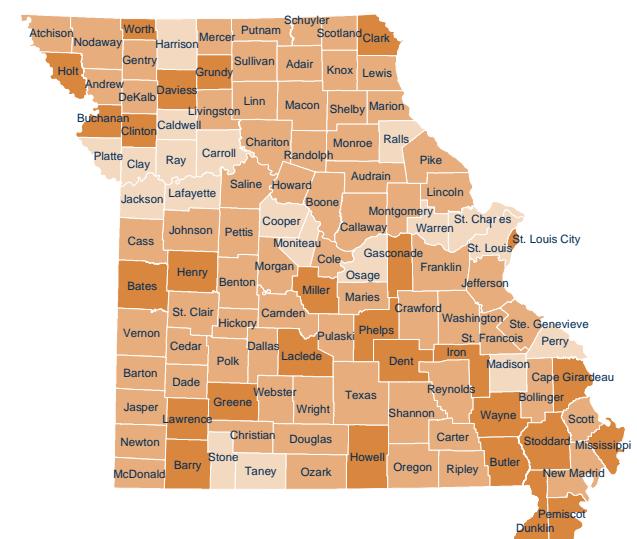


Age-Adjusted Heart Disease Hospitalizations

Missouri State Rate = 164.9 (per 10,000)

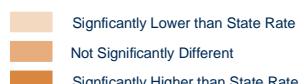


Map 4. Stroke Mortality: Missouri, 1995-2005

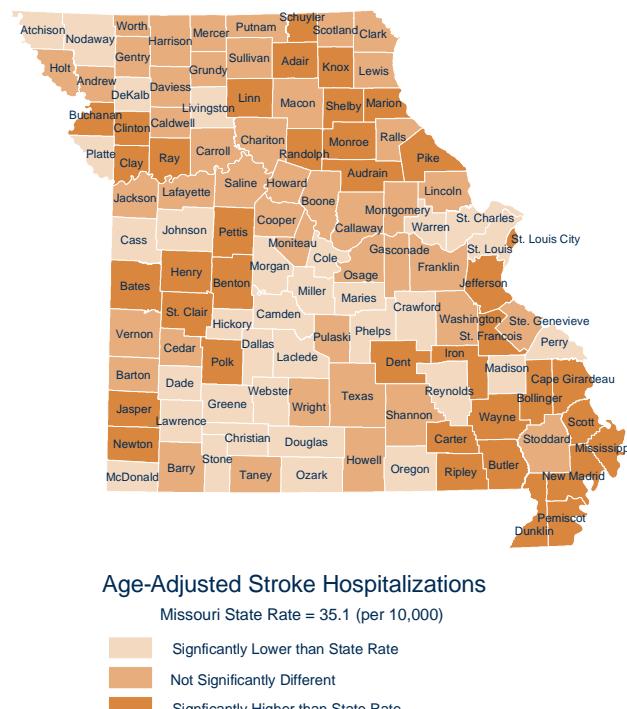


Age-Adjusted Stroke Mortality Rates

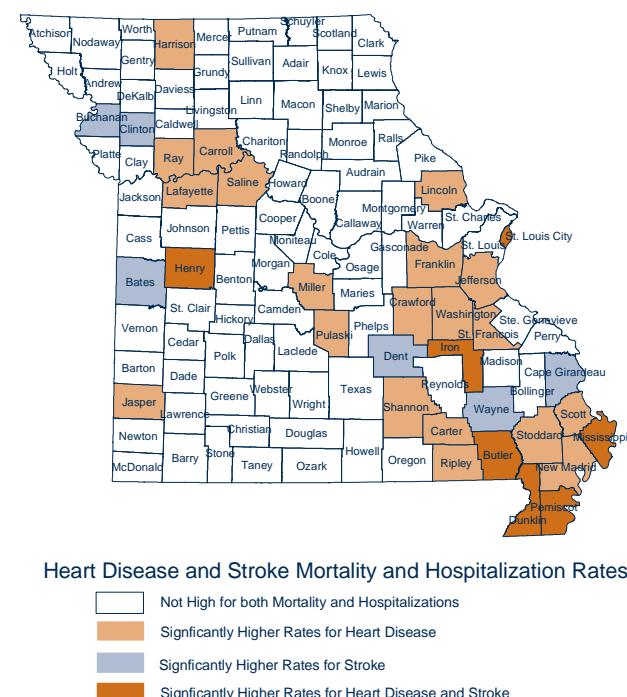
Missouri State Rate = 62.2 (per 100,000)



Map 5. Stroke Hospitalizations: Missouri, 1995-2005



Map 6. Significantly High Rates for Heart Disease and Stroke Mortality and Hospitalizations: Missouri, 1995-2005



Sixteen of the 27 counties with significantly high heart disease rates were located in the southeastern quadrant of the state. Eight of the 13 counties with high stroke rates were also located in southeastern Missouri. There was also a cluster of four counties east of Kansas City that had high heart disease rates. The appendix of the report delineates deaths and inpatient hospitalizations and rates for heart disease and stroke for all Missouri counties.

The primary factor that links most of these counties with high cardiovascular disease rates appears to be low socioeconomic level. A study by the Missouri Department of Health and Senior Services (DHSS) in 2003¹³ ranked counties by socioeconomic level based on the following variables from the 2000 Census: poverty rate, percent of employed persons that have professional or managerial jobs, percent of adults with less than a high school education, and unemployment rate. Based on summary indicators of these four variables, counties were divided into quartiles. Six of the seven counties that had high rates for all four heart disease and stroke indicators ranked in the lowest quartile for socioeconomic rank. Fifteen of the 27 counties with high heart disease rates and 8 of the 13 counties with high stroke rates were also ranked into the lowest socioeconomic quartile.

Low socioeconomic level also was associated with heart disease and stroke prevalence, along with many of the modifiable risk factors that increase the risk of cardiovascular disease, such as hypertension, lack of physical activity, smoking, and poor nutritional habits. Low socioeconomic groups were also less likely to recognize all of the symptoms of a heart attack or stroke. Of course, other factors may also contribute to high heart disease and stroke rates, such as genetics or lack of access to adequate medical care.

Conclusions

In Missouri, as in the United States, heart disease is the leading cause of death and stroke is the third-leading cause of death. In 2004, Missouri's heart disease death rate was 13.5 percent higher than the national rate and the stroke death rate was 11 percent higher. These differentials expanded from 1995 to 2005 despite a decrease of 27 percent in Missouri's age-adjusted heart disease death rate and a 24 percent decrease in the stroke death rate.

With these mortality decreases, Missouri met the 2010 objectives for both coronary heart disease and stroke mortality in 2006.

Missouri's age-adjusted hospitalization rate for heart disease was 17 percent higher than the national rate in 2004, while Missouri's stroke hospitalization rate was 9 percent higher than the national average.

Heart disease inpatient hospital dispositions in 2005 were 4.5 times more frequent than stroke inpatient hospital dispositions. Heart disease deaths in inpatient hospital settings were statistically significantly lower in 2005 versus 2001. Ischemic stroke inpatient hospital dispositions were nearly 5 times more frequent than hemorrhagic stroke inpatient hospital dispositions. In contrast to ischemic stroke patients, a greater percentage of hemorrhagic stroke patients died.

Prevalence of heart disease and stroke was also higher in the state than the national average, as Missouri ranked 9th in heart disease prevalence and 7th in stroke prevalence in 2005.

Missouri had higher rates than the United States in 2005 for all seven modifiable risk factors studied, which included hypertension, high cholesterol, currently smoking, physical inactivity, eating fruits and vegetables less than five times per day, obesity, and diabetes. Reduction in these risk factors could help reduce Missouri's relatively high heart disease and stroke mortality and prevalence rates. Missouri also had a lower median income and an older population than the nation.

Heart disease and stroke are currently costing the nation more than \$200 billion in direct medical costs, with \$165 billion for heart disease and \$41 billion for stroke. Missouri hospital charges in 2005 for heart disease were nearly \$3 billion, and stroke hospital charges were nearly \$500 million.

From 2001 to 2005, the indirect costs measured in terms of lost productivity due to premature deaths resulting from heart disease for Missouri were \$1.75 billion annually. Premature mortality due to stroke in Missouri cost nearly \$251 million in lost productivity annually.

Heart disease death rates and hospitalization rates were considerably higher for males than for females. Premature (under age 65) heart disease death rates were nearly double for males compared to females. Stroke death rates did not vary as much by gender.

Heart disease and stroke death rates among African Americans were one-fourth to one-third higher than that for whites. Hospitalization rates for heart disease and stroke were also higher for African Americans than for white Missourians. Premature heart disease death rates were about double the rates for whites, while premature stroke death rates were triple the corresponding rates for whites.

Geographically, high heart disease and stroke death rates were found in the southeast quadrant of the state, the city of St. Louis, and scattered places around the rest of the state for 1995-2005 data. Seven counties had significantly high rates for all four indicators studied, which were heart disease and stroke death rates and heart disease and stroke hospitalization rates. These seven counties were Pemiscot, Mississippi, and Dunklin in the Bootheel; Butler and Iron in southeast Missouri; Henry, southeast of Kansas City; and St. Louis City. Low socioeconomic status is prevalent in these areas and appears to be associated with higher rates of death and hospitalization for heart disease and stroke.



Data Sources and Technical Notes

Mortality

Mortality data are primarily from Missouri death certificates filed with the Missouri Department of Health and Senior Services (DHSS), Bureau of Vital Records. All the mortality data in this report are based on Missouri deaths to persons who reside in Missouri most of the time, regardless of where the deaths occurred. Missouri also cooperates with other states in the exchange of death records to include deaths to Missouri residents in other states. County data are also based on county of residence.

"Cause of death" refers to the underlying cause of death. The underlying cause of death is defined as the disease or injury that initiated the chain of events leading directly to death. The *International Statistical Classification of Diseases and Related Health Problems*, 10th Revision (ICD-10), was used to define cause of death from 1999 to the present. For 1995-1998, ICD-9 was used. Table 12 defines the primary codes used in this report.

All mortality rates (except where noted otherwise) were age adjusted by the direct method, using the United States 2000 population as the standard. Age-adjusted rates are computed by applying age-specific rates in a population of interest to a standardized age distribution in order to eliminate differences in observed rates that result from age differences in population composition. For example, a county with an

older population may display a higher observed or crude heart disease or stroke death rate than another younger county simply because of the differences in age distribution. Age adjustment allows better comparison of the true risk of death.

National mortality data are from the National Center for Health Statistics, Centers for Disease Control and Prevention (CDC).

Years of Potential Life Lost

Years of potential life lost (YPLL) are a measure of premature mortality. YPLL is presented for persons less than 75 years of age because the average life expectancy in the United States is over 75 years. YPLL-75 is calculated by subtracting the age of death from 75 and then summing years of life lost for all deaths for a given cause.

Hospitalizations and Emergency Room Visits

Hospitalization data are based primarily on inpatient hospital stays in Missouri hospitals as reported to the Patient Abstract System, which was established in 1993. Emergency room (ER) visits and discharge disposition are also from the Patient Abstract System, which DHSS manages. Hospitalization and ER data represent encounters, not individuals. Therefore, the same individuals could be represented multiple times. Those seen in the ER that are subsequently admitted to

Table 12. ICD-9 and ICD-10 Codes Used for Calculating Death, Hospitalization, and ER Data

Cause	ICD-9 Codes	ICD-10 Codes
Diseases of the Heart	390-398,402,404,410-429	I00-I09, I11, I13, I20-I51
Coronary Heart Disease	402,410-414,429.2	I1, I20-I25
Stroke	430-434,436-438	I60-I69

the hospital are excluded from the ER data. Both data sets presented in this report include resident data only. Missouri receives hospitalization data for Missouri residents from Iowa, Kansas, and parts of Illinois, but it does not receive ER data from any other state. Hospitalization data for Missouri counties near other state lines (and the Hannibal/Quincy, Ill., area) need to be considered with particular caution, because the data from the bordering states may be incomplete or missing. The discharge dispositions of rehabilitation facilities may be underreported because reporting that information is not required.

The primary diagnosis listed in the patient's medical record was used for categorizing heart and stroke hospitalizations and ER visits. ICD-9 codes were used to classify diagnoses for hospitalizations for all years presented in this report (1995–2005). The codes are the same as the ICD-9 codes shown above for mortality, with the exception that code 435 is also included for stroke hospitalizations and ER visits.

Hospital charge data also come from the patient abstract file and only includes charges for inpatient hospitalizations. Haddix, et al.,⁹ estimated that charges represent about double actual costs.

Comparable national data on hospitalizations were obtained from the National Hospital Discharge Survey of 2004 from the National Center for Health Statistics, CDC.

Prevalence and Risk Factors

Missouri data for prevalence, modifiable risk factors, and knowledge of heart attack and stroke symptoms all come from the Missouri Behavioral Risk Factor Surveillance System (BRFSS). Comparable national and other state data are from the national BRFSS from the CDC. The BRFSS data are collected through random-digit-dialed monthly telephone interviews with non-institutionalized, civilian adults aged 18 and over using standardized protocols and interviewing techniques. Only people with landlines were included in the BRFSS. Preliminary results from the 2006 National Health Interview Survey¹⁴ show that

about one out of eight American households did not have a landline telephone, primarily because of the increasing use of cell phones. Younger people were more likely not to have landlines.

In 2005, there were 5,164 respondents in the Missouri BRFSS, representing about 58 percent of the original sample. Response rates were lower for persons with lower levels of education and income and for African Americans. BRFSS data are available by gender and by race as well as by income and education level, but the rates are much less stable for these subgroups.

MICA

DHSS maintains a data system called Missouri Information for Community Assessment (MICA), which is accessible on its website, www.dhss.mo.gov/MICA. The MICA system provides chronic disease and other information from multiple data systems to make health data accessible at the community level through a web-based, interactive user format. MICA currently enables users to produce summary statistics, including age-adjusted rates from 30 different data files, including BRFSS, deaths, hospitalizations, and ER visits. Tables can be generated on the website by year, age, gender, race, county, and ZIP code of residence.

Productivity Losses

Deaths caused by diseases of heart and stroke by age group for the years 2001–2005 were used to compute the productivity losses attributable to these deaths. Because there are no Missouri-specific estimates of Present Discounted Value Future Earnings (PDVFE), this report uses the 2000 national estimates.¹² The PDVFE was computed by age and gender with a 3 percent discount rate. The productivity losses due to heart- and stroke-related deaths were generated using age-specific annual death rates for 2001–2005. The same data were used to calculate the average of age at death for the two causes by gender and race.

Appendix

Deaths and Inpatient Hospitalizations and Rates by County for Heart Disease and Stroke: Missouri, 1995-2005

Death rates are age adjusted to U.S. 2000 Standard Population per 100,000 population, and hospitalization rates are age adjusted per 10,000 population.

Sig.=Significance

H=Significantly higher than the state rate

NS=Not significantly different from state rate

L=Significantly lower than the state rate

County/City	Deaths				Inpatient Hospitalizations				
	Heart Disease		Stroke		Heart Disease		Stroke		
	Number	Rate	Sig.	Number	Rate	Sig.	Number	Rate	Sig.
Adair	800	280.2	NS	179	60.6	NS	4,544	179.5	H
Andrew	559	255.8	L	155	68.8	NS	2,635	131.9	L
Atchison	305	241.9	L	98	76.8	NS	1,016	91.8	L
Audrain	929	238.1	L	230	57.7	NS	6,692	192.4	H
Barry	1,391	308.1	H	362	79.6	H	6,537	146.9	L
Barton	421	226.5	L	132	69.5	NS	2,633	159.1	NS
Bates	750	293.6	NS	204	77.6	H	5,323	232.0	H
Benton	741	256.3	L	178	62.0	NS	5,361	183.2	H
Bollinger	515	345.3	H	91	61.6	NS	2,509	167.9	NS
Boone	2,296	210.2	LS	640	59.1	H	14,623	130.8	H
Buchanan	3,164	276.4	NS	909	75.9	H	18,513	179.2	H
Butler	1,693	301.6	H	428	75.3	H	11,146	208.2	H
Caldwell	401	290.8	NS	60	42.3	L	2,2061	79.1	H
Callaway	1,030	263.3	L	261	67.7	NS	7,307	178.1	H
Camden	1,349	281.4	NS	262	58.2	NS	7,631	140.0	L
Cape Girardeau	2,686	313.1	H	629	72.0	H	10,550	131.4	L
Carroll	649	342.4	H	80	41.4	L	2,700	173.3	H
Carter	303	403.0	H	48	62.7	NS	1,804	235.1	H
Cass	2,138	247.7	L	557	65.0	NS	12,703	145.2	L
Cedar	671	281.2	NS	163	64.9	NS	3,355	155.4	L
Chariton	498	287.6	NS	93	52.0	NS	1,988	139.6	L
									517
									34.5 NS

(continued)

County/City	Deaths				Inpatient Hospitalizations				
	Heart Disease Number	Rate	Sig.	Stroke Number	Rate	Sig.	Heart Disease Number	Rate	Sig.
Christian	1,346	270.9	NS	317	65.4	NS	7,397	136.9	L
Clark	277	245.3	L	96	82.5	H	1,675	140.1	L
Clay	3,928	232.2	L	895	53.8	L	31,317	169.5	H
Clinton	674	259.2	L	190	73.2	H	4,436	190.3	H
Cole	1,914	256.5	L	435	58.2	NS	4,450	193.0	H
Cooper	637	272.2	NS	122	50.3	L	2,953	142.4	L
Crawford	953	39.8	H	177	58.9	NS	5,302	183.2	H
Dade	393	280.5	NS	101	68.9	NS	1,757	143.5	L
Dallas	505	251.3	L	105	51.7	NS	2,700	137.0	L
Daviess	351	298.4	NS	110	91.0	H	1,877	171.5	NS
DeKalb	449	302.9	NS	87	57.9	NS	1,747	124.9	L
Dent	696	305.9	NS	193	82.1	H	4,726	230.5	H
Douglas	435	232.3	L	104	56.1	NS	2,024	112.7	L
Dunklin	1,735	370.8	H	434	90.5	H	7,979	186.2	H
Franklin	3,005	308.1	H	643	66.8	NS	17,414	171.5	H
Gasconade	762	292.7	NS	223	82.8	H	3,998	182.6	H
Gentry	394	293.8	NS	109	75.0	NS	2,270	205.4	H
Greene	7,306	248.8	L	1,979	66.2	H	37,500	136.1	L
Grundy	566	297.7	NS	169	79.5	H	2,656	164.0	NS
Harrison	585	315.1	H	58	32.9	L	2,637	184.8	H
Henry	1,103	312.6	H	329	88.0	H	5,975	185.5	H
Hickory	425	242.2	L	103	60.7	NS	2,441	147.2	L
Holt	236	213.6	L	104	87.1	H	1,151	128.0	L
Howard	340	220.9	L	101	62.5	L	1,812	134.6	L
Howell	1,532	289.8	NS	456	84.8	H	9,795	198.0	H
Iron	580	368.2	H	138	84.8	H	3,246	223.8	H
Jackson	18,915	260.6	L	4,265	58.6	L	111,657	155.7	L
Jasper	4,142	328.5	H	824	64.4	NS	21,314	177.3	H
Jefferson	5,088	330.1	H	960	63.6	NS	35,147	192.2	H
Johnson	1,226	304.2	H	221	55.3	NS	6,353	153.7	L
Knox	215	273.4	NS	60	75.8	NS	1,075	155.4	NS
Laclede	1,380	357.3	H	279	72.5	H	6,162	158.5	L
Lafayette	1,622	346.5	H	221	46.7	L	7,233	170.8	H

(continued)

County/City	Deaths				Inpatient Hospitalizations			
	Heart Disease Number	Rate Sig.	Stroke Number	Rate Sig.	Heart Disease Number	Rate Sig.	Stroke Number	Rate Sig.
Lawrence	1,323	272.4 NS	424	87.1 H	6,350	141.6 L	1,473	31.5 L
Lewis	446	270.1 NS	120	72.8 NS	2,278	169.8 NS	495	35.1 NS
Lincoln	1,179	315.7 H	224	61.1 NS	7,405	190.5 H	1,376	36.4 NS
Linn	731	281.1 NS	159	58.1 NS	3,509	161.5 NS	932	39.8 H
Livingston	796	298.2 NS	173	63.7 NS	3,374	155.6 L	742	31.5 L
McDonald	597	278.4 NS	117	54.8 NS	2,966	131.1 L	611	27.8 L
Macon	784	287.6 NS	163	55.2 NS	3,903	164.8 NS	921	36.5 NS
Madison	540	301.3 NS	80	43.3 L	3,097	192.6 H	518	30.5 L
Maries	354	321.0 H	706	6.0 NS	1,802	161.1 NS	319	28.3 L
Marion	1,315	295.4 NS	254	56.5 NS	6,638	179.6 H	1,644	42.4 H
Mercer	181	245.7 NS	35	46.9 NS	1,096	166.5 NS	244	35.2 NS
Miller	1,010	323.2 H	230	72.3 H	5,346	182.7 H	970	32.0 L
Mississippi	812	435.2 H	152	80.6 H	3,743	217.7 H	915	50.8 H
Moniteau	557	296.2 NS	98	50.3 L	3,362	198.4 H	588	33.5 NS
Monroe	386	258.8 NS	83	53.2 NS	2,348	176.8 H	563	40.7 H
Montgomery	537	271.2 NS	104	51.0 NS	2,938	173.1 H	659	36.7 NS
Morgan	839	283.3 NS	166	55.6 NS	5,302	186.9 H	949	32.0 L
New Madrid	1,005	385.5 H	167	64.1 NS	4,892	198.7 H	998	39.3 H
Newton	1,701	272.8 NS	378	60.8 NS	11,447	182.7 H	2,379	37.6 H
Nodaway	730	248.4 L	223	70.7 NS	4,022	158.2 L	669	25.1 L
Oregon	559	350.7 H	99	62.6 NS	2,506	170.1 NS	438	28.5 L
Osage	498	293.8 NS	77	45.2 L	2,857	181.9 H	535	32.8 NS
Ozark	372	266.8 NS	102	73.5 NS	1,787	121.6 L	387	25.8 L
Pemiscot	1,159	456.1 H	214	80.6 H	6,200	267.8 H	1,158	46.7 H
Perry	722	279.3 NS	128	47.7 L	2,975	126.9 L	737	30.0 L
Pettis	1,315	252.7 L	347	65.0 NS	9,105	188.2 H	1,895	37.4 H
Phelps	1,323	275.6 NS	374	77.4 H	9,827	214.7 H	1,559	33.1 L
Pike	659	263.8 NS	153	59.9 NS	3,973	173.6 H	919	38.8 H
Platte	1,285	210.0 L	275	46.4 L	9,862	142.5 L	2,105	32.5 L
Polk	851	239.0 L	251	69.6 NS	5,703	172.1 H	1,334	38.6 H
Pulaski	863	327.2 H	178	69.7 NS	6,239	209.1 H	926	32.8 NS
Putnam	263	282.3 NS	44	46.6 NS	1,384	157.8 NS	346	38.4 NS
Ralls	310	258.1 NS	55	46.0 L	1,728	143.5 L	397	33.0 NS

(continued)

County/City	Deaths				Inpatient Hospitalizations				
	Heart Disease		Stroke		Heart Disease		Stroke		
	Number	Rate	Sig.	Number	Rate	Sig.	Number	Rate	Sig.
Randolph	945	281.1	NS	191	55.5	NS	5,860	195.1	H
Ray	914	349.9	H	132	51.0	L	5,338	200.3	H
Reynolds	264	297.4	NS	45	52.6	NS	2,155	239.1	H
Ripley	674	353.1	H	131	67.5	NS	3,685	202.5	H
St. Charles	5,227	247.8	L	1,046	50.5	L	41,453	165.3	NS
St. Clair	489	279.1	NS	113	62.2	NS	3,672	237.3	H
St. Francois	2,285	328.5	H	429	61.4	NS	14,846	216.9	H
St. Louis	34,295	274.4	L	7,322	58.4	L	183,119	149.9	L
St. Louis City	14,921	346.8	H	2,918	67.3	H	71,413	183.1	H
Ste. Genevieve	565	257.9	L	114	51.5	NS	4,392	203.2	H
Saline	1,153	321.4	H	231	62.9	NS	5,375	173.3	H
Schuyler	149	190.0	L	526	6.1	NS	1,216	182.4	H
Scotland	184	219.2	L	687	5.6	NS	1,117	145.9	L
Scott	1,509	310.4	H	343	69.6	NS	9,406	198.6	H
Shannon	335	319.6	H	656	3.9	NS	1,848	174.7	H
Shelby	352	264.9	NS	96	64.4	NS	1,787	170.4	NS
Stoddard	1,333	300.5	H	366	80.5	H	7,053	172.2	H
Stone	926	228.0	L	188	48.7	L	5,648	130.7	L
Sullivan	308	253.1	NS	685	4.8	NS	1,460	139.9	L
Taney	1,439	277.8	NS	260	49.8	L	9,551	183.7	H
Texas	1,035	301.4	NS	205	59.8	NS	5,843	178.0	H
Vernon	934	318.1	H	180	61.1	NS	4,196	158.9	L
Warren	733	278.2	NS	130	49.9	L	5,309	188.8	H
Washington	994	443.1	H	131	60.6	NS	5,713	232.1	H
Wayne	604	290.7	NS	163	78.0	H	3,485	176.6	H
Webster	988	311.4	H	200	63.3	NS	4,870	150.1	L
Worth	124	251.4	NS	50	90.5	H	667	166.4	NS
Wright	810	322.0	H	155	60.6	NS	3,705	157.1	L
Missouri	187,501	282.3		41,476	62.6		1,066,789	164.9	
									35.1

Source: DHSS at <http://www.dhss.mo.gov/DeathMICA/indexcounty.html> and <http://www.dhss.mo.gov/cgi-bin/inpathosp>

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Notes



